THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXXII. No. 791.] LONDON, JULY 9, 1878. [30TH YEAR.] Price 6d.

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1862.

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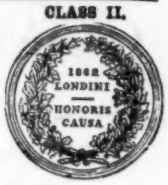
CLASS II.



This Paint having been in general use over sixteen years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known. Its advantages are that—

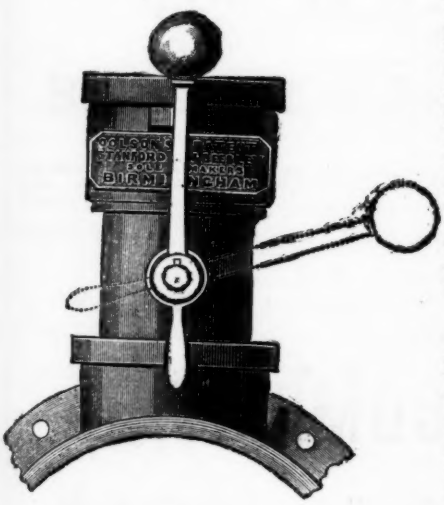
It does not require DRIERS like other Paints.

It does not poison the painter like white lead. No colic by its use.

It has greater durability in colour, as sulphurous gases do not blacken it as they do white lead.

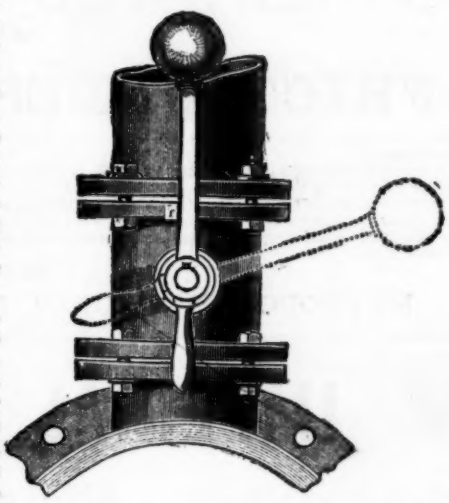
It is of a light stone colour, and has a body equal to white lead, and as its specific gravity is so much less, it covers equally well one-third more surface, by which a great saving is effected; a similar economy arises from its use in steam and gas joints, for which purpose it is superior to white lead.

COLSON'S PATENT ASCENSION-PIPE THROTTLE-VALVE.



THIS Valve is designed to supersede the hydraulic seal, and is intended to be placed immediately in or on the retort mouthpiece, or at such a distance therefrom as to be within reach of the workman. By the use of these Valves, the whole of the pressure is removed from the retorts, and a largely increased make of gas per ton obtained; the deposit of carbon is very slight, choked ascension-pipes are unknown, and the quality of the coke is improved.

When the retort is being drawn or charged, the lever, which is attached to a Spindle and Throttle-Valve, is thrown over as shown by the dotted lines, thereby closing the ascension-pipe; but when the retort is sealed, the lever is placed in a vertical position, and a free way made for the gas to pass to the relieving main.



Upwards of one hundred of these Valves have been continuously at work during the past six months at the Windsor Street Works of the Corporation of Birmingham, and no difficulty has been experienced in working retorts fitted with them in combination with others worked in the usual way with the hydraulic seal.

The following important testimonial has been received:—

Corporation of Birmingham Gas Department, Windsor Street Works, Feb. 17, 1878.

MESSRS. STANFORD AND BEESLEY.

DEAR SIRS,—In reply to your inquiry, I beg to say that the Valves (Colson's Patent) supplied by you in July last have given entire satisfaction. The retorts fitted with them are worked side by side with others having the ordinary dip-pipe, without any difficulty being experienced.

Yours truly, (Signed) CHARLES HUNT.

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Beg to intimate to Gas Companies and others that they are now prepared to supply these very superior Meters at the same prices as for the ordinary Gas-Meters.

In the construction of this Meter, for which the best tin plates only are used, every mechanical contrivance has been taken advantage of successfully to reduce the friction to a minimum, which is amply proved by the fact that they are made to work upon only one-fortieth of an inch pressure. By an improvement also in their construction, a steadier light is obtained, and greater capacity than can be got from any other Meter in the market. No gas can pass under the valves on any back pressure, as is the case with many other Dry Meters.

To Gas Companies supplying gas through streets with heavy gradients, these Meters are invaluable, as much gas is saved from the low pressure required to work them.

ALL METERS ARE UPHELD FOR FIVE YEARS.

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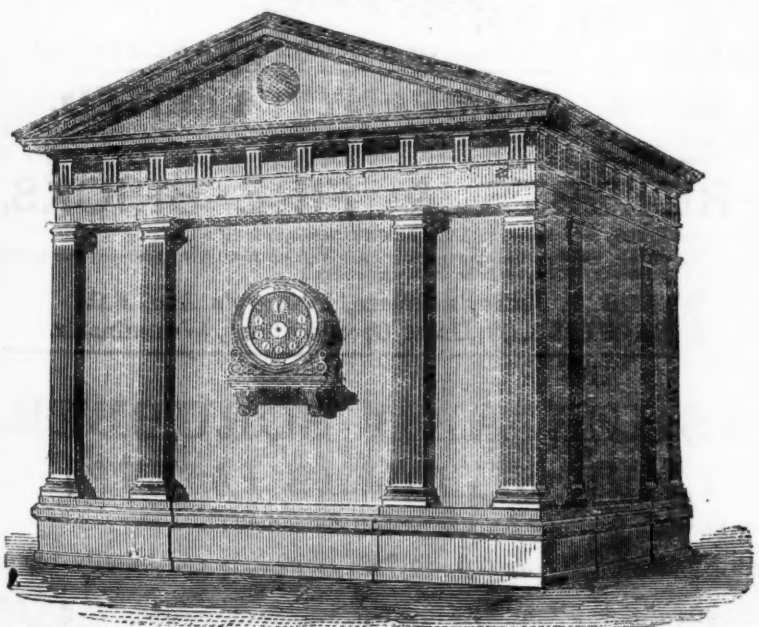

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Home and Foreign Orders promptly attended to.

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Specially adapted for painting Iron and Woodwork in and about **Gas-Works**, as it is not affected by the ammoniacal gases always present, but will keep its **Colour and Hardness** under the most trying circumstances; it forms a very hard surface, and effectually prevents iron from corroding; it will not crack or blister, and resists alike the heat of summer and the cold of winter.

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Of every size and shape, and of the best quality; also of White and Coloured GLAZED BRICKS, SANITARY PIPES, &c., &c.

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[KIRKHAM, HULETT, AND CHANDLER'S PATENT.]

Some of the advantages claimed for this Apparatus are as follow:—

The Exposing of a large Amount of Effectually-wetted Surface (which is continually reproduced) to act upon the Gas.
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Economy of Space, thus enabling the Apparatus to be protected from the Weather.
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It works without Pressure.
It is particularly adapted for Gas-Works where Sulphate of Ammonia is manufactured.

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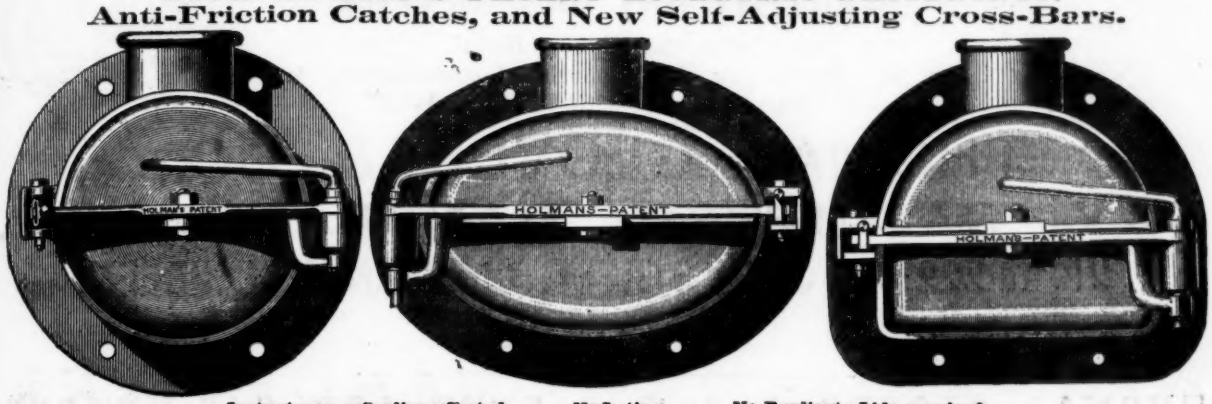

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Holman's New Self-Sustaining Cross-Bar ensures freedom of Joint, and maintains parallel position of the Lids.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested, being now in use in nearly all the principal Gas-Works in London and the Provinces.

T. B. and H. are now making the "Morton's Self-Sealing Lid" of the SAME FORM OR SECTION AS THE RETORT (see Illustrations above), as well as bringing the Mouthpiece from the D or Oval at back to Circular in front, as heretofore.

D and Oval Morton's Lids are working satisfactorily both in this country, on the Continent, and in the United States of America. Among others they have been adopted by the following Gas-Works:—

The Gaslight Company's Works, Fulham; Ditto, Bromley-by-Bow; Ditto, King's Cross; Ditto, Shoreditch.
And also in the Gas-Works at Richmond, Maidstone, Gloucester, Glasgow, Portsea, Roubaix (France), The Hague (Holland

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at an convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.

These Governors have been adopted by many leading Gas Companies, among whom are the following:—

The Gaslight and Coke Co. (9), The London Gas Co. (3), and at Abergavenny, Arundel, Birmingham, Cannes (France), Devonport, Dursley, Exeter, Guernsey, Halesowen, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, Windsor, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1878.

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

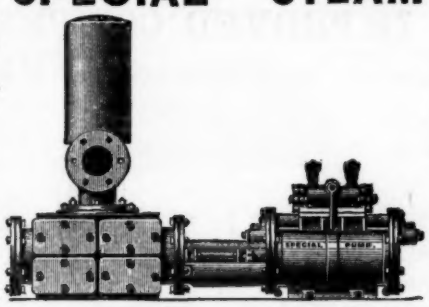
Yours truly,

(Signed) JOHN JOHNSON.

PRICES AND FULL PARTICULARS ON APPLICATION.

THE "SPECIAL" STEAM-PUMP.

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4	2	9	815	18
5*	2½	12	1,250*	20
5*	3	12	1,830*	22 10
4	4	12	3,250	25
6*	4	12	3,250*	30
5	5	12	5,070	32 10
7*	5	12	5,070*	40
6	6	12	7,330	40
8*	6	12	7,330*	50
7	7	12	9,750	50
10*	7	12	9,750*	65



In use in a Hundred Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

Messrs. Burt, Boulton, and Haywood, Manufacturing Chemists, have over FORTY "Special" Steam-Pumps in use at their several large Tar-Works.

Two Hundred Sizes made. Those in Table opposite are the leading Sizes for use in Gas-Works and Chemical Works.

* These Sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance-piece between steam and pump cylinder, at a small extra cost.

TANGYE'S HIGH-PRESSURE AND CONDENSING STEAM-ENGINES; CORNISH, VERTICAL, & TUBULAR BOILERS; HYDRAULIC AND SCREW LIFTING-JACKS, CRABS, PULLEY-BLOCKS, &c.

FULL PARTICULARS, ESTIMATES, CATALOGUES, ETC., ON APPLICATION.

London, 1851 New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865.

The SIX MEDALS AWARDED to THOMAS GLOVER for

PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

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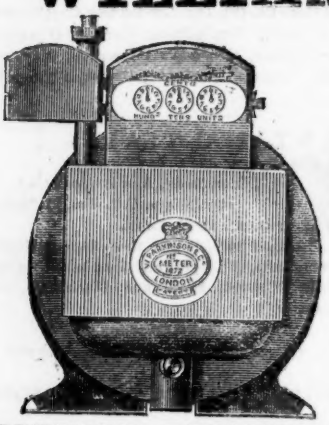


(ESTABLISHED 1816,)

MANUFACTURERS OF

WET & DRY METERS,

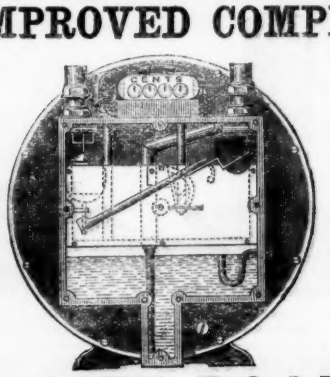
STATION-METERS & GOVERNORS,

EXHAUSTER REGULATORS,

PRESSURE REGISTERS, EXPERIMENTAL APPARATUS, GAUGES, WATER-METERS, &c.

HUNT'S PATENT IMPROVED COMPENSATING METER.

In this Meter, the action of the measuring-drum is reversed. By this arrangement an improvement is effected in the registration at high speeds, which, in many tests, has not varied from the smallest light to three times the capacity of the meter. It works equally well under all pressures. The range of error between the high and low line is much smaller than that allowed by the "Sale of Gas Act."



The Meter has been critically tested, and most favourably reported upon by official Meter Inspectors in London and Birmingham.

W. PARKINSON and CO. have made arrangements for the manufacture of these Meters, both in tin and cast-iron cases, and for the alteration of old ones to this principle, which is confidently recommended as possessing every quality that can be desired by Gas Companies, Corporations, or Private Consumers.

COTTAGE LANE, CITY ROAD, LONDON, E.C.

CONTENTS.

	Page
Circular to Gas Companies:—	
British Association of Gas Managers	49
Mr. Penny on the Transfer of Gas-Works	49
Mr. G. Livesey on Capital and Revenue	49
Meeting of the North British Association of Gas Managers	50
Mr. Forstall on the Advantage of Removing the Dip	50
Transfer of the Droitwich Gas-Works	50
The Normanton Gas Bill	50
The Brighton Corporation and the Recent Gas Explosion	50
Quarterly Report of the Chief Gas Examiner of the Metropolis	50
Water and Sanitary Notes:—	
Schemes for Disposing of the Sewage of the Lower Thames Valley	50
The East London Water Company and Constant Supply	50
The Stockton and Middlesbrough Water-Works Purchase—How Corporations obtain Loans	50
The Warrington Water Bill	50
The Manchester Water Committee and the Use of Water	50
The Liversedge Local Board and the Rawfolds Water Company	50
The Metropolitan Board of Works and the Epping Forest Bill	51
Correspondence:—	
Regenerative Furnaces	51
Leakage	51
Sewage Gas	51
Parliamentary Intelligence:—	
Progress of Bills in House of Lords	51
Progress of Bills in House of Commons	51
Miscellaneous News:—	
The Annual Dinner of the Inspectors of The Gaslight and Coke Company	51
Metropolis Gas Supply	52
Metropolis Water Supply	52
Phœnix Gas Company's New Gasholder	52
British Association of Gas Managers	53
Reductions in the Price of Gas	60
On the Advantage of Removing the Hydraulic Seal during the Distillation of Coal. By Mr. Theobald Forstall	61
Transfer of the Exeter Gas-Works to the Exeter Corporation	63
Trade Reports	63
Lambeth Water-Works Company	64
Suffocation by Gas	61
Register of New Patents:—	
Barker and Harris—Ball and other Draw-off Valves	61
Brothers, W.—Manufacture of Retorts, &c.	64
Hardisty, G. E.—Cocks and Taps	64
Fox, W. P.—Spanners or Wrenches	64
Applications for Letters Patent	64
Patents which have become void	64

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THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 9, 1878.

Circular to Gas Companies.

IN the valuable paper read by Mr. Penny at the recent Meetion of the British Association of Gas Managers, and which we publish in another column, he takes up the exact line of argument that has always been followed in this JOURNAL. He very properly regards gas undertakings as the offspring of commercial enterprise, and points out that in no case, except that of Manchester, have Local Authorities initiated gas-works. It is not strictly true in the case of Manchester, for there the Police Commissioners of the day commenced with the purchase of a commercial undertaking. It is right also to say that Local Bodies never dream of buying up Gas Companies until they have become prosperous. At this day, happily, Gas Companies are almost universally prosperous, and hence the rage for the acquisition of their properties. Recent legislation, which widens the basis of Companies, some people affect to think will remove the desire of Local Authorities to acquire gas undertakings. The diminution of capital entitled to share in the profits will, no doubt, in the course of time, enable Companies to supply gas at a price below that at which Corporations could furnish it; but, unless the Scottish system which we advocate be insisted upon, Local Authorities will invariably endeavour to make large profits, with the absurd idea that they are thereby relieving the rates. Mr. Penny points out that the auction clauses are a grievous wrong to the existing Shareholders of Companies upon whom the Legislature had conferred a statutory right. In our opinion, the sliding scale offers but a small mitigation of the wrong; and, further, we are quite satisfied that, whenever that provision begins to operate generally in favour of Shareholders, an outcry will be made for its abolition. The right of Gas Companies to a reserve-fund is undoubted, and it is recognized in the most recent enactments—including the sliding scale, which allows the application of profits, in excess of those required to pay standard dividends, to the formation of such a fund. How far Gas Companies can resist the prevailing tendency of the day, it is difficult to say, but we hope that, in every instance, transfers will be strongly opposed. The chief thing to be done is to remove all possible cause of complaint; for, in the absence of any just grounds of objection to a Company's operations, the Legislature almost invariably looks with greater favour on the commercial body, and, in the worst instance, gives the highest terms for the transfer. These, in the case of statutory Companies, are now pretty well settled; they are at least twenty-five years purchase of maximum dividends. But, in the case of transfer, non-statutory Companies labour under a considerable disadvantage; their price is said to be sixteen and three-quarters years purchase. Wisely, then, does Mr. Penny recommend all Companies but the smallest to make application to Parliament for a special Act, or, at all events, a Provisional Order.

To this recommendation we need hardly add a word of approval. Gas Companies should, in all possible cases, protect themselves by special Act. By these means they secure themselves against competition on the one hand, and place themselves in a position to obtain better terms, if, when successful, the cupidity of the Local Authority prompts a desire to purchase.

Mr. G. Livesey's paper on "Capital and Revenue" was a noteworthy contribution to the proceedings of the Association. Nothing could be sounder economically than the author's views as to the nature of capital, and what should be represented by it; but, unfortunately, it rarely happens, in the case of Gas Companies of long existence, that the amount of money expended can be fairly represented by the value of the plant. Theoretically, the proposition laid down is undoubtedly sound, but, practically, it is found extremely difficult to maintain the position. It is all very well to recommend that preliminary expenses and the cost of an Act of Parliament, &c., should be written off; but it must be remembered that Shareholders are clamorous for dividends, and, as Mr. Livesey shows further on, they desire the expenditure of a large amount of capital on which to receive interest. As regards the amount of capital which should be expended on works, the author is no doubt right, when circumstances favour; but it is impossible to fix an absolute standard. No one knows better than Mr. Livesey that the cost of works varies greatly. We allude only to the original cost, and take no notice of the instances that lie under our eyes, in which a large amount of capital represents nothing at all.

It is impossible to lay down any law on the subject. That land may be bought, works constructed, and distributing plant laid down, on which, and with which, a ton of coal may be carbonized, and the gas produced distributed, the capital expenditure not exceeding £5, is within the author's own knowledge, and, therefore, beyond dispute; but this can only be the case with original works, under somewhat exceptional circumstances. The older Companies who have had works which have become effete and worn out, and who may possibly have been driven from their early sites and compelled to erect fresh works in new situations, could hardly keep their capital within the limits which Mr. Livesey prescribes. Efforts ought, however, to be made in all such cases to reduce the capital as far as possible, and to keep it within reasonable limits. We may here remark that Shareholders are fairly entitled to all the law allows them, and whenever the expenditure of further capital can be justified, it should be raised. Mr. Livesey, we notice, as a Shareholder, is dissatisfied with the auction clauses, but submits to them with equanimity. He might have said more on the subject; but as his words would have been thrown away, they were as well left unsaid. With the sliding scale, to which he stood godfather, he is naturally much more pleased. Safe, in his own case, for, at least, a ten per cent. dividend—unless, indeed, very extraordinary circumstances should occur—he may, with propriety, recommend other Companies to reconcile themselves to the downward operation of the scale when another coal famine happens. We need hardly repeat here that we regard the old legislation as perfectly satisfactory; and if it had been thoroughly carried out, we do not think the public would have grumbled. Scarcely any attempts, for instance, were made to enforce the clauses of the Act of 1860, which were intended for the protection of consumers. As much may be said of the Act of 1847; but this Act, as Mr. Livesey points out, was passed when it was expected that the consumers would be protected by competition. In these days, however, when competition is dead, some automatic means are required to save the interests of the public, and these are supposed to be found in auction clauses and the sliding scale. Time alone can show how far these will satisfy at once Consumers and Companies. But these latter are now rapidly passing away. Purchase, as Mr. Livesey says, stares every Company in the face; and here

he, perhaps not quite consistently, drops a useful hint. When transfer is considered, it is undoubtedly a misfortune for a Company to have a small capital. The author gives two illustrations, which show that a Company with a small capital in relation to production obtain much less for an undertaking than another with a relatively larger capital. Against any waste of capital in the ornamentation of works, Mr. Livesey is naturally averse. Quakerlike sobriety of style and not too great solidity, he thinks, should be the rule. Contractors, of course, admire solid structures, and Managers may be, at times, tempted to indulge their taste.

But we need not follow Mr. Livesey further through his admirable paper. It will be read with pleasure and profit by those who did not attend the meeting, and will, no doubt, be perused by those even who had the opportunity of hearing it read.

Of the discussions which followed the reading of the two papers to which we have alluded above, we may say that they did the speakers much credit. They showed that Gas Managers are fully alive to the importance of the financial concerns of their employers, and that they are quite fit to advise them when such matters come up for consideration.

The North British Association of Gas Managers will commence their Seventeenth Annual General Meeting at St. Andrew's, on the 11th inst. This year it is intended to devote two days to the business, and the time will, no doubt, be well occupied. The papers to be read include one entitled "How should the "Illuminating Value of Gas be Determined?" by Mr. A. Macpherson; another on "The Necessity for a Proper Control over "the Pressure of Gas for Illuminating Purposes," by Mr. A. Mitchell; a third on "Governors for Lamps and Stair Lights," with a description of an improved metallic governor which will be shown in action, by Mr. D. B. Peebles; and, lastly, Mr. D. M. Nelson will describe "A Graduatory Method of Condensing, "Washing, and Purifying Coal Gas by a Combined Process of "Rotary Apparatus." The work cut out seems little for the extended time, but no doubt the Members will find in the Exhibition of Gas Apparatus sufficient to engage their attention to fill up the period.

Of the advantages to be derived from the removal of the hydraulic seal during the distillation of coal, no one, we think, now entertains a doubt; but, if there should be a sceptic, he would be convinced by the paper of Mr. T. Forstall, of New Orleans, which we publish in another column. It appears, however, that these advantages are not so great as some have imagined. The increase in the production of gas under equal heats, with and without the seal, differs only to a small extent, unless a vacuum be maintained, in which case the author points out that the additional gas comes from the furnace, and is not generated in the retort. But it seems clear that less carbon is deposited, and there is no doubt that the durability of the retort is prolonged when the seal is removed. The advocates, then, of the removal of the dip find a firm supporter in Mr. Forstall.

The undertaking of the Droitwich Gas Company was duly handed over to the Corporation of that Borough on the 1st inst., and the Company are now in process of winding up.

The Normanton Gas Company have succeeded in carrying their Bill through both Houses of Parliament without any alteration. They were opposed by the Local Board, who desired to have a clause inserted giving them power to purchase, and also on the ground that the standard price fixed was too high. Their opposition was, however, not successful, and, as we have said, the Bill passed without alteration.

It seems that the Brighton Town Council will not further contest their liability for the damage done by the late gas explosion in the King's Road. They have selected Mr. Turner as their arbitrator, and proceedings respecting the arbitration will commence forthwith.

We publish in another column an abstract of the report of the Chief Gas Examiner of the Metropolis, for the quarter which has just expired. We note with great satisfaction that the illuminating power of the gas was maintained far above the parliamentary standard, except in two instances, when it fell but little below that standard. As regards the sulphur impurity, Dr. Williamson remarks that the *average* has in every instance been below the requirements of the Referees. It must be remembered, however, that Companies are not protected by quarterly averages, but are liable to prosecution for daily defaults. At this season of the year, purification is a simple business; but when winter comes again, we are afraid the old difficulty will recur. Ammonia was kept within the prescribed limits, for it is now too valuable to be thrown away. The Companies who come under the supervision of the Chief Gas Examiner may well be congratulated on keeping up to statutory requirements and the exigencies of the Referees.

Water and Sanitary Notes.

THE Lower Thames Valley Main Sewerage Board have plenty of work cut out for them. In response to invitations, they have received designs and estimates for the execution of twenty-eight schemes for the disposal of the sewage of the combined districts they represent. Some of the plans, we ought to say, include alternative schemes, so that the number the Board will have to consider is really larger than we have stated. The majority of these schemes are for irrigation in one or other of the districts to be drained. Ham Fields has been selected by several Engineers. There are seven precipitation schemes, Ham Fields being again selected by most as the site for the works. Of course, Sir Joseph W. Bazalgette's scheme for joining the Lower Thames Valley with the West Kent system of drainage is to be brought before the Board, and there is also another scheme for carrying the sewage independently into the Thames at Sea Reach. Messrs. Gotto and Beesley make a bold proposal to take the sewage across the country, and turn it into the sea at Littlehampton. The estimates vary from £126,786, for a precipitation scheme to be carried out at Ham Fields, to £592,600, for irrigation on land at Chobham and Bisley. The Littlehampton scheme it is estimated would cost £490,202. We do not envy the Board the task of deciding which particular scheme should be carried into execution. The larger number will, of course, be rejected after short consideration, but the difficulty of making the final decision will not thereby be lessened.

The East London Water-Works Company still continue to extend the system of a constant supply, and now give notice that, towards the end of this year, they will bring under the system a large district in the parishes of St. George's-in-the-East, St. Anne's, Limehouse, and the hamlet of Ratcliff. The praiseworthy exertions of the Company to confer the benefits of a constant supply are received as ungraciously as ever by the Metropolitan Board of Works.

The joint Water Board of the two Corporations of Stockton and Middlesbrough have paid over to the Water Company the purchase-money, amounting to £800,000, leaving a small balance for expenses still outstanding. Where Middlesbrough obtained their loan, we are not informed; but Stockton applied to a Financial Agent in the City of London. It was agreed by the Corporation of Stockton to pay a commission of one per cent., so that they actually only received ninety-nine per cent. The Financial Agent took them to the Anglo-Foreign Bank (*Limited and Reduced*), who agreed to put the loan on the market, and made an immediate advance of £225,000. The debentures have since been advertised by the Bank at a premium of two-and-a-half per cent.; and so the Bank will have done a good stroke of business, if they succeed in persuading the public to invest in the debentures. The interest to be paid is four-and-a-quarter per cent., which is secured by the mortgage of the water-works, the borough rates and funds, including gas profits. It seems odd that the loan could not be obtained from the Bank of England, or from some insurance offices. Is it possible that the credit of Stockton is not good in the market? It is a heavy debt for Stockton to incur, and the payment of the interest and the sinking-fund, which is to wipe out the debt in thirty years, will be a somewhat severe tax; but when the good times come again, it will not be much felt. One thing is quite certain—the inhabitants of Stockton and Middlesbrough will long have to put up with the much-abused water from the Tees; for a new supply, with such a load of debt, is at present out of the question.

The Warrington Corporation, having withdrawn their opposition to the Bill of the Water Company, it has now passed the Committee stage. We are not fully informed as to the circumstances which induced the Corporation to withdraw their opposition; but we understand that the Company have undertaken to supply water from several sources, when it has been declared pure by a public analyst to be appointed at the Quarter Sessions.

Manchester, the city of a model water supply, is not always satisfied. Recently, stinking water was sent into one district, and the supply from the Gorton reservoir had to be cut off. Complaints were also made, at a meeting of the Town Council, of a deficient supply at a fire which occurred some time ago, when the Deputy-Chairman of the Water Committee made the somewhat startling assertion that mains were not laid for the extinguishing of fires; if they were of sufficient capacity to supply water for domestic purposes, that was all that was required. This is, as we have said, a somewhat startling doctrine in Manchester.

The Liversedge Local Board recently entered into an agreement with the Rawfolds Water Supply Company to take over

the undertaking of the latter, paying 35s. for each £1 share. After the agreement had been duly signed and made binding, it transpired that on many of the shares only 5s. had been paid. When this was discovered, the Board wished to be off the bargain. They have been met in a very fair spirit by the Company, who have offered to call up the full value of the shares, or to sell such as are not fully paid at a *pro ratâ* reduction. The Board have had notice that ten days are given them for considering the proposal, and if an answer be not received within the time specified, the Company will take proceedings to enforce the bond entered into.

The officiousness of Mr. Fawcett, no doubt prompted, brought the other evening another snub upon the Metropolitan Board of Works. On the third reading of the Epping Forest Bill, promoted by the Corporation of the City of London, the honourable Member for Hackney proposed that four Members of the Metropolitan Board of Works should be appointed to act with the Committee of the Common Council. Now, in 1864, the Board, when invited by the Government of the day, refused to undertake the charge of the Forest, on the ground that it lay beyond their jurisdiction. In 1869 the Board made the audacious proposal that the estate should be divided amongst the Lords of the Manors—an act which Mr. Shaw Lefevre very properly asserted must deprive the Board of all sympathy in the question. Sir James M'Garel Hogg affected innocence, and the House promptly rejected Mr. Fawcett's proposal by a majority of 160.

Correspondence.

[*We do not hold ourselves responsible for the opinions expressed by Correspondents.*]

REGENERATIVE FURNACES.

Sir,—In the "Circular to Gas Companies" in this week's Journal of Gas Lighting, you refer to the Siemens furnaces in use at the works of the Paris Gas Company, and to the advantage resulting from the use of them in economy of fuel, &c.

Not having been able to join the excursion to Paris, I have not had the opportunity of seeing these furnaces, but I have for some time been much interested in a form of regenerative furnace now acquiring somewhat extensive application in Germany, and I should like to know in what the Siemens furnaces at Paris differ from it. I allude to the so-called "generator" furnace patented by Herr Liegel, Manager of the Gas-Works at Stralsund.

Of this furnace, I am in possession of working drawings received from the inventor himself, and shall be very pleased to send you copies of them for publication in the Journal of Gas Lighting, if you can, some day, find space for them. The furnace may be applied to each setting of retorts singly, or a whole bench of retorts may be heated by one furnace, placed at the end of the back, or even outside the retort-house. This method of heating has been for some time in use at the works of the Frankfort New Gas Company, where it is said to be very successful, the fuel account averaging from 16 to 18 per cent. of the coal carbonized. The Liegel furnace is now also being introduced into the works of the German Continental Gas Company, who possess several important gas-works, renowned for their exceptionally good working results.

Besides economizing fuel, the Liegel furnace reduces the labour of firing to a minimum, as, by an ingenious arrangement of the fire-bars and air-channels, clinkering is rendered quite unnecessary.

Peterborough Gas-Works, July 4, 1878. G. Ernest Stevenson.

LEAKAGE.

Sir,—If your correspondent, T. F., whose letter appeared in your last issue, be desirous of gaining information on the exosmotic action of gases, I would refer him to a letter on the subject of "leakage," addressed to yourself by the writer, signed "Charlemagne," and courteously published in the Journal of December 16, 1873 (Vol. XXII., p. 1081), wherein the law of gaseous diffusion is exemplified, and the "supposition" advanced by your correspondent, and which he apparently considers original, is treated in the concluding paragraphs of my communication. Charles Edwin Jones.

Chesterfield Water and Gas Works, July 5, 1878.

SEWAGE GAS.

Sir,—In reply to Mr. James Hellyar, as to how the sewage sludge is dried so as to have only 9·14 per cent. of moisture, I may say that it was dried in a machine patented by Mr. J. H. Kidd, of Wrexham. The machine consists of four half cylinders, placed one over the other in a horizontal position, set in a chamber through which hot waste gases are passing, or the machine may have a furnace specially built. The half cylinders have each a shaft passing through them with screw blades revolving, for the purpose of travelling the sludge from end to end, the half cylinder being 7½ feet long. The sludge is put in at one end of the topmost cylinder, and is traversed to the other end, where it drops into the cylinder immediately underneath, and this repeats the process until finally the sludge makes its exit at one end of the bottom cylinder, having travelled a distance of 30 feet in ten minutes. For your correspondent's information, I may say that the sludge is allowed to drain after being taken out of the settling-tanks, so that when it enters the machine it contains about 60 per cent. of moisture. I believe the cost of drying will be about 4s. per ton. I may say that one great advantage of drying by waste fuel gases is that any sulphur in the fuel being converted into sulphuric acid, combines with any ammonia that might otherwise escape.

In reply to "C. R. N.," as to the production of good illuminating gas, and at what cost per 1000 cubic feet, I may say that, on reference to the analysis of the unpurified gas, it will be seen that there is 2·5 per cent. of sulphuretted hydrogen. This would have to be removed by passing the gas through an oxide of iron purifier, then through carburetting chambers, charged with light spirits of petroleum having a specific gravity of 0·650°. About two gallons of spirit would be required for 1000 cubic feet, producing a quality of about 16-candle gas. If the petroleum spirit was bought in quantity, it would cost about 1s. 3d. per gallon. T. A. Collingе, Analyst.

Rochdale Corporation Gas-Works, July 6, 1878.

Parliamentary Intelligence.

HOUSE OF LORDS.

Monday, July 1.

Radcliffe and Pilkington Gas Bill,—reported specially, without amendment.

Tuesday, July 2.

A petition in favour of the Gas-Works Clauses Bill was presented from the Corporation of Elgin.

Thursday, July 4.

The following Bills received the Royal Assent:—Public Health Act (1875) Amendment; Bangor Local Board; Bradford Water and Improvement; Cardiff Water; Drumcondra, Clonliffe, and Glasnevin Township; Grand Junction Water; Hamilton Burgh; Leicester Corporation; Lichfield Gas; Limerick Corporation Gas; Maryport Improvement; Newry Gas; Normanton Gas; Stoke-upon-Trent Corporation Gas; Trowbridge Water.

Radcliffe and Pilkington Gas Bill,—read the third time, and passed.

Weston-super-Mare Improvement Commissioners Bill,—read the third time, with the amendment, and passed.

Newbury Borough Extension Bill,—read the third time, with the amendments; further amendments made; and Bill passed.

Friday, July 5.

Exeter Gas Bill, South Staffordshire Water Bill, Sutton-in-Ashfield Gas Bill.—Commons amendments considered and agreed to.

Public Health (Ireland) Bill,—read a second time, and committed.

HOUSE OF COMMONS.

Monday, July 1.

Maryport Improvement Bill, Public Health Act (1875) Amendment Bill.—Lords amendments agreed to.

Normanton Gas Bill (Lords),—read the third time, and passed, with amendments.

Exeter Gas, Sutton-in-Ashfield Gas Bills (Lords),—as amended, considered.

South Staffordshire Water Bill (Lords),—as amended, considered; clause added.

Tuesday, July 2.

Drumcondra, Clonliff, and Glasnevin Township Bill, Limerick Corporation Gas Bill.—Lords amendments agreed to.

Castleford and Whitwood Gas, Exeter Corporation Water, Forfar Water, Mansfield Commissioners Gas Bills (Lords),—reported, with amendments.

Wednesday, July 3.

Warrington Water Bill (Lords),—as amended, considered.

Thursday, July 4.

Exeter Gas, South Staffordshire Water, Sutton-in-Ashfield Gas Bills Lords),—read the third time, and passed, with amendments.

The Annual Dinner of the Inspectors of The Gaslight and Coke Company took place at the Crown Hotel, Broxbourne, on Monday, the 1st inst. The superintendence of the arrangements for this interesting reunion was confided to a committee of officers, selected from the several districts comprised in the large area of the Company's operations, and they appear to have given the most entire satisfaction. The party, numbering about 80, assembled at the Liverpool Street station of the Great Eastern Railway, at 9.30 a.m., and were speedily conveyed to the scene of the day's festivities, where, after a substantial luncheon, they proceeded to spend several hours in rambling about the beautiful grounds adjoining the hotel, or taking part in the various pastimes—cricketing, archery, boating, &c., provided for them. Dinner was served at four o'clock, J. Johnson, Esq., the respected chief officer of the Company's Outdoor Department, presiding, and the vice-chairs being occupied by two of the divisional inspectors, Messrs. Dillon and Fenn. A glance at the bill of fare shows that the Committee had been very properly mindful of the vast responsibilities connected with this part of their duty, and the united voice of the guests testified that "mine host" of the Crown understood how to carry out their hospitable designs. Full justice having been done to the repast, the cloth was withdrawn, and the usual loyal toasts were proposed and responded to. The Chairman then gave—"The Gaslight and Coke Company," coupling with it the name of their able and esteemed Secretary, Mr. John Orwell Phillips, whom he very appropriately designated "the Bismarck of the gas world." In the course of his speech, he alluded to the vast extent of the Company's operations, arising out of the various amalgamations which have taken place, and congratulated the Company that they were served by an able body of officers, many of whom were long honourably connected with the undertakings absorbed by them. He mentioned the facts that the Company's district extended from Beckton, in Essex, to Stonebridge, in Middlesex; and that, during every quarter, no less than 180,000 consumers meters were examined, and a similar number of accounts made out in the short space of ten or twelve days. He said he had authority for stating that the Secretary was much in favour of gatherings like the present, and he hoped in future years the number of officers present on similar occasions would be considerably augmented. The toast was heartily responded to. Mr. Dillon proposed—"The Rental Department," coupled with the name of its head officer, Mr. Vaughan. In the unexpected absence of this gentleman, Mr. Worthington, one of the collectors, responded. Mr. Fenn proposed—"The Stores Department," to which Mr. J. H. Pearson replied. The Chairman next proposed the health of Mr. T. C. Hersey, Assistant Chief Inspector, followed by that of the Divisional Inspectors, to which Mr. Dillon responded. "The Dinner Committee," for whom Mr. Ball, their Secretary, replied, was very cordially received, the company present being evidently impressed with a conviction that the labours of those gentlemen had been wisely planned and judiciously carried out. Then followed—"The Ladies," to which Mr. Poulton appropriately replied; the final toast being "The Chairman." The reception which this toast met with unmistakeably proved the great respect in which Mr. Johnson is held by the entire staff under him. Between the toasts and speeches, songs and recitations were given, Mr. Webb accompanying the former on the pianoforte. The party broke up at ten o'clock, and arrived safely in London about eleven, highly gratified with their day's entertainment.

Miscellaneous News.

METROPOLIS GAS SUPPLY.

ABSTRACT OF THE QUARTERLY REPORT OF THE CHIEF GAS EXAMINER.—Professor Williamson, F.R.S., has issued his report on the results of the daily testings of the gas supplied by The Gaslight and Coke Company, the South Metropolitan Gaslight and Coke Company, and the Commercial Gas Company, during the quarter ending June 30, 1878; and the following is an abstract of it:—

1. *Illuminating Power*—

	Max.		Min.		Aver.
The Gaslight and Coke Company—					
Beckton	18·0	..	15·9	..	16·9
Friendly Place	16·8	..	16·2	..	16·5
Millbank Street	24·0	..	20·0	..	21·5
Ladbroke Grove	19·7	..	16·5	..	17·7
Bruce Terrace	18·7	..	16·3	..	17·7
Carlyle Square	17·9	..	16·4	..	17·3
Camden Street	18·0	..	16·0	..	16·8
Graham Road	18·7	..	17·0	..	17·6
South Metropolitan Gas Company—					
Hill Street, Peckham	19·5	..	15·7	..	17·3
Commercial Gas Company—					
Wellclose Square	17·6	..	16·5	..	17·1
Parnell Road	19·3	..	16·6	..	17·6

From these results it will be seen that the average at all the stations has been above the standard required by the Acts of Parliament.

2. *As regards Purity.*—Sulphuretted hydrogen has not been present in the gas at any of the stations, with one exception—viz., Bruce Terrace, Devon's Road, on the 27th and 28th of June—now under investigation by the Chief Gas Examiner.

Grains of Sulphur per 100 *Cubic Feet of Gas.*

	Max.		Min.		Aver.
The Gaslight and Coke Company—					
Beckton	12·9	..	6·0	..	9·8
Friendly Place	14·8	..	5·5	..	10·8
Millbank Street	17·1	..	10·5	..	13·0
Ladbroke Grove	21·2*	..	2·8	..	9·0
Bruce Terrace	14·3	..	5·5	..	8·8
Carlyle Square	18·3	..	8·0	..	13·5
Camden Street	18·3	..	10·1	..	13·5
Graham Road	17·0	..	9·3	..	13·2
South Metropolitan Gas Company—					
Hill Street, Peckham	23·9	..	7·8	..	13·5
Commercial Gas Company—					
Wellclose Square	15·4	..	8·1	..	12·3
Parnell Road	18·2	..	4·5	..	13·0

* Disputed.

From these results it will be seen that the average at all the stations has been below the parliamentary limits.

Ammonia has been present at most of the stations to a slight extent. There was a slight excess on one occasion at Wellclose Square.

The stations of the Commercial Gas Company were re-opened in the middle of May.

METROPOLIS WATER SUPPLY.

The following are the returns of the Society of Medical Officers of Health, on the Composition and Quality of the Metropolitan Waters in June, 1878:—

NAMES OF WATER COMPANIES.	Total Solid Matter per Gallon.	Oxygen required by Organic Matter, &c.	Nitrogen. — As Nitrates, &c.	Ammonia. — Saline.	Ammonia. — Organic.	Hardness (Clark's Scale). — Before Boiling.	Hardness (Clark's Scale). — After Boiling.
Thames Water Companies.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Grand Junction	20·80	0·101	0·135	0·000	0·009	14·3	2·8
West Middlesex	19·10	0·073	0·114	0·000	0·008	13·2	2·8
Southwark and Vauxhall	19·30	0·098	0·114	0·001	0·010	14·3	2·8
Chelsea	19·80	0·090	0·099	0·001	0·009	14·3	2·8
Lambeth	20·70	0·098	0·144	0·001	0·011	14·8	3·3
Other Companies.							
Kent	28·50	0·003	0·444	0·000	0·002	20·6	5·1
New River	19·90	0·045	0·144	0·000	0·006	14·8	3·3
East London	20·40	0·056	0·114	0·000	0·006	14·3	3·3

Note.—The amount of oxygen required to oxidize the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

The water was found to be clear and nearly colourless in all cases.

C. MEYMOTT TIDY, M.B.

PHŒNIX GAS COMPANY'S NEW GASHOLDER.

MR. CORBET WOODALL, M.INST.C.E., ENGINEER.

(*Continued from Vol.* XXXI., *p.* 986.)

On a separate double sheet we give, with the current JOURNAL, drawings Nos. 1 and 2, showing some of the details of the holder, the tank of which has been already described and illustrated.

The holder is telescopic, the diameter of the outer lift being 215 ft. 3 in., and its depth from the top of the grip 44 ft. The top row of the side sheets of the outer holder are $\frac{5}{16}$ in. thick, except opposite the vertical stays, where they are $\frac{3}{8}$ in. thick; the next to it and the bottom row, $\frac{1}{4}$ in.; the third row from the top and the second from the bottom, No. 7 B.W.G.; and the intermediate rows, No. 11. The plates of the bottom row are 12 ft. in length.

The top row of side sheets of the inner holder are $\frac{1}{4}$ in. thick, the one next to it, and the bottom row forming the inside of cup, $\frac{1}{4}$ in. thick; the next to it, and the third from the top, No. 7 B.W.G.; and the remainder No. 11 B.W.G.

The first row of roof sheets from the curb are $\frac{3}{8}$ in. thick and 4 ft. wide, formed of good boiler plate; the second row, $\frac{7}{16}$ in. thick, 3 ft. 16 in. wide; and the third row, $\frac{1}{4}$ in. thick and 3 ft. wide. The centre plate is 8 ft. in diameter and $\frac{3}{8}$ in. thick, and the first row from it, No. 5 B.W.G., and 4 ft. 6 in. long. Radiating from these centre plates to the row of $\frac{1}{4}$ in. plates are 12 strips (one opposite alternate columns), 2 ft. wide, No. 7 B.W.G., dividing the remaining roof sheets into 12 sections. The outer sheets of these sections, which join the $\frac{1}{4}$ in. plates, also those joining the No. 7 sheets, are of No. 8 gauge, and all the remainder are No. 11. They are all arranged in the manner shown in drawing No. 1. The $\frac{3}{8}$ in. plates of the outer row are 6 ft. in length; the joints are planed and bolted exactly together, covered by double jointing pieces, 5½ in. wide and ½ in. thick, rivetted on each side with $\frac{7}{8}$ in. rivets, 2½ in. apart, and, where these joint plates are covered by the second row of roof sheets, they are hammered down to $\frac{1}{4}$ in. thick, and the $\frac{1}{4}$ in. plate set on them.

The joint with channel of top curb is made with a double line of $\frac{7}{8}$ in. rivets, 2½ in. apart. The second row of plates overlaps the first by 3½ in., and is attached to it by a double row of $\frac{7}{8}$ in. rivets, 2½ in. apart. The plates of this row and of the third are attached to the adjoining plates in a similar manner, but with $\frac{3}{4}$ and $\frac{1}{4}$ in. rivets respectively. The cross joints of the outer three rows of roof plates come as nearly as possible, each opposite the centre of the plate adjoining it, and all these joints were well caulked inside and out, and rivetted hot, as were also the $\frac{1}{4}$ in. rivets joining No. 8 sheet of roof to third row centre and radiating sheets.

The timber framing in the tank, upon which the roof sheets rest when the holder is out of action, having a rise of 8 ft. in the centre, all the roof sheets are set to this rise, the two outer rows of plates being carefully hammered so that they form part of a true curve when the centre of the crown is 8 ft. 6 in. above the top of the curb.

The top curb is formed by a channel iron 10 in. by 3½ by ½ in., swept to the requisite curve with perfect exactitude. It is attached to the top row of the side plates by a triple, and to the first row of the top plates by a double row of rivets (respectively $\frac{7}{8}$ in. and $\frac{3}{4}$ in.), spaced as in drawing. The sections of this curb are 20 ft. long, jointed by bars of channel iron 6 ft. long, of a size to fit inside exactly, the edges being forged so that the two lie close together. In the position shown on drawing is rivetted a ring of channel iron, of the same section as the curb, with rivets $\frac{3}{4}$ in. diameter and 4 in. apart in two lines. The rivet holes next the radial joints of the roof plates were set out with care, so as to avoid coming opposite the rivets of that joint. The joints of the channel iron are formed with a plate $\frac{3}{8}$ in. thick outside, and channel iron inside, each 4 ft. long, rivetted together through the main bar by a double line of 1 in. rivets 4 inches apart.

The two channel irons described are connected at top by the row of $\frac{3}{8}$ in. roof plates, and at the bottom by a $\frac{1}{4}$ in. plate, as drawn. The latter is in lengths of 6 ft., butt jointed, double jointing strips 5½ in. by ½ in., rivets $\frac{3}{4}$ in., 3 in. centres, no joint in these plates being allowed in any case to come within 12 inches of a vertical stay.

On the inner edge of the second row of roof plates is rivetted a ring of angle iron 6 in. by 5 in. by $\frac{3}{4}$ in., by a double row of $\frac{3}{4}$ in. rivets, 4 in. centres. The bars of this ring are 20 ft. long, and jointed by fish plates of 5 in. by $\frac{1}{4}$ in. angle iron inside, and 5 in. by $\frac{3}{8}$ in. flat outside, each 4 ft. long, and rivetted to each other through the bar by a double row of $\frac{3}{4}$ in. rivets, 4 in. centres.

Vertical stays are fixed inside the holder, one opposite each standard, and immediately between them, of the form shown in drawing No. 2. These stays are 18 in. deep from side sheets, and in width those next the standards are 18 in., the intermediate ones being 12 in. They are formed of two girders, each in two lengths, with tables of 3 in. by $\frac{3}{8}$ in. angle iron, attached to each other by lattice bars of 3 in. by $\frac{3}{8}$ in. in front and sides, and by holder sheets at back. The two lengths are bolted together through a $\frac{3}{8}$ in. gusset plate, the full width of the vertical stay by 4 ft. 6 in. long. None of the stays, main or intermediate, have lattice bars, side or front, above a height of 35 ft.; from thence they are replaced by $\frac{1}{4}$ in. plate. That in front is attached to the inner channel iron of the curb by twelve $\frac{3}{4}$ in. rivets.

At the top of posts the back angle irons are forged so as to fit the angle made by the top curb and side sheets, turned out across the curb plate and returned to meet the angle irons in front. The rivets used throughout the posts, and in attaching them to the side sheets, are ½ in., and spaced 6 in. centres. The rivets attaching to the curb plates are $\frac{3}{4}$ in., and the lattice bars are fastened by two $\frac{1}{4}$ in. rivets at each end. At the bottom, the stay is finished by riveting $\frac{1}{4}$ in. plate across the angle irons, and they are carried by straps of 6 in. by 5 in. by $\frac{3}{4}$ in. angle irons, rivetted to the bottom plates. At intervals of 5 ft. in height, $\frac{7}{16}$ in. plates are rivetted across each stay, the whole depth, as stiffeners. The intermediate curb is formed of T-iron, 5 in. by 4 in. by $\frac{1}{4}$ in., fixed midway between the top curb and cup, rivetted and bolted to the side sheets at distances of 12 inches on each side of the web. This T-iron is attached to the vertical stays by $\frac{3}{8}$ in. gusset plates.

To the inside of the top plates 48 bars of 4 in. by 3 in. by ¼ in. angle iron, 3 feet long, are fixed on the plates, and turned down so as to admit of bolting to the lower plate of the curb, for taking the bolts securing the top carriages.

The grip round the top of the outer holder, with which the cup of the inner holder corresponds, is formed of bridge or channel iron, 9 in. by 3½ in. by ½ in., in lengths of 20 ft., curved to the proper radius, and attached to the top row of side sheets by a double line of $\frac{3}{4}$ in. rivets, 2½ in. apart, that row of sheets forming one side of grip, The inner side is 18 in. deep, and formed of 1½ in. plate, stiffened at the lower edge with a ring of 2½ in. by ½ in. half-round iron of the section shown. This ring is attached to the plate by $\frac{3}{4}$ in. countersunk rivets, 6 in. apart. The lengths of the bridge iron are joined by $\frac{7}{16}$ in. plates 24 in. long, bent to the form, and rivetted through the top with 36 $\frac{3}{4}$ in. rivets, 18 on each side of the joints. At the sides, these plates are secured by the same rivets that attach the side sheets to the bridge iron. The inside face of the bridge iron of grip and cup are made perfectly flush throughout, the bolt and rivet holes being countersunk for that purpose. The same remark applies to the channel iron guides, and to all places where there is a possibility of rivet heads being rubbed. The joints, in lengths of bridge irons, of cup and grip, the channel iron guides, and stiffener, both intermediate curbs, and all angle and T-irons, are planed so as to butt exactly.

Round the bottom of the outer holder are rivetted two rings of angle iron, each 6 in. by 5 in. by $\frac{3}{8}$ in., by double rows of $\frac{3}{4}$ in. rivets, 2½ in. apart. These are fixed, in relation to each other, as shown in drawing No. 2. To the under side of the lower angle iron, by a double row of $\frac{7}{8}$ in. rivets, 6 in. centres, is attached a $\frac{3}{4}$ in. plate, 12 in. wide, and shaped to the proper sweep. Between the two angle irons the carriages for the guide rollers are fixed.

Midway between the top of the grip and the bottom of the holder is a curb of railway iron, 45 lbs. per yard, which is attached to the sheets by suitable rivets at distances of 12 in. apart on each flange. These bars are forged at the ends where they butt against the vertical stays, so that two $\frac{3}{4}$ in. bolts might be used at each end to attach stay and curb together, the vertical stays being countersunk inside for these bolts.

Against the inside of the holder, in the positions drawn, there are fixed 48 wrought-iron channel irons, 7 in. by 3 in. by ½ in., by $\frac{3}{8}$ in. rivets, 12 in. apart, on alternate sides. The rivets attaching to the bridge iron of grip and the angle irons of the bottom curb are $\frac{3}{4}$ in. Knees of 4 in. by 3 in. by ½ in. angle iron, 10 in. by 6 in., are attached to the sheets inside, by rivets going through to the angle irons of bottom curb. The weight of the stays was carried by this means before they were rivetted to the side sheets, and the two sets of knees are connected by a 1 in. bolt and nut on each side of stay. Each channel iron stay is in one length, and 24 of them were carried down below the bottom of the sheets in the manner shown on the drawing, so as to project below the guide wheels on the cup of the inner holder when the latter is at rest.

At 24 positions round the outside of the holder, opposite the columns, are fixed vertical stays, as shown. Two angle irons, 6 in. by 3 in. by ½ in. are rivetted to the grip plate and bottom plate of the holder, with $\frac{3}{4}$ in. rivets. These angle bars are 10 in. apart, and at the bottom the 6 in. member of the bars is turned out upon the top angle iron of curb, and attached to the same by $\frac{3}{4}$ in. bolts and nuts. The stays are finished at top with a ½ in. plate, bent over, so as to form a double gusset plate, which is rivetted to the angle irons with eight $\frac{3}{4}$ in. rivets at each side. At the bottom they are bolted to the curb with $\frac{3}{4}$ in. bolts, and are stiffened intermediately by six distance washers and 1¼ in. bolts. They are also attached to the side sheets by $\frac{3}{8}$ in. rivets, 10 in. apart.

(*To be continued.*)

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from p.* 26.)

TUESDAY, JUNE 18.

The first paper was by Mr. W. Richards, and was read by Mr. F. W. HARTLEY, in the absence of the writer. The subject was—

BRICK, CONCRETE, AND COMPOSITE TANKS.

In the construction of gasholder-tanks, the first consideration is, of course, the stability of the ground, that the foundation shall be sufficiently solid, in order to sustain the weight of the tank, water, and holder, without settlement; but, as this is essential in every class of structure, further reference to it will not be made.

The other important points connected with my subject are—the nature of the building materials employed in the bulk of the work, whether these be brick, stone, shingle, gravel, or other similar substances. Also the means of uniting or cementing these materials together, either with hydraulic lime mortar, which possesses its hydraulic property in consequence of the lime containing a quantity of argil; or whether a purer lime be employed, and rendered hydraulic by an admixture of a substance such as Puzzolana; or by the employment of Portland or other cements. Lastly, we have to consider the proper means of employing these materials, which, as will be shown hereafter, constitute the most important of the operations in the construction of tanks.

It may be briefly stated that bricks, brick ballast, as well as some kinds of stone, are more or less porous; but how far this influences the proper construction of a tank I will have occasion to demonstrate. On the other hand, many kinds of stone, as well as shingle, the pebbles entering into the formation of gravel, and the grains of sand, so far as regards their impermeability, leave nothing to be desired. With these, therefore, the means of uniting them together with hydraulic mortar or cement is all that is requisite in order to form a tank, at least so far as regards the materials employed.

Respecting the mortars and cements, it may be observed that hydraulic limes can only be obtained in certain localities; and, as they are not sufficiently valuable to bear heavy expenses in carriage, for these reasons their use is limited. Puzzolana is comparatively little known in England, which is to be regretted, on account of its great value; indeed, such is this value, that when a small portion of Puzzolana is intermixed with good lime mortar, whether for concrete or other uses, the compound possesses nearly all the properties of Portland cement, except that it requires a longer time to set and harden. Moreover, as Puzzolana exists in the neighbourhood of Edinburgh, opportunities are afforded for its more general employment in the United Kingdom, which is further encouraged by its low price, and the small quantity required to be intermixed with the mortar in order to render it hydraulic.

There are various kinds of hydraulic cements, but that which experience has proved to be the best for our purpose is the Portland, and to which my observations will be principally confined.

Among the advantages this possesses are—its moderate price, that it can be mixed with two and even three times its volume of clean sand and still retain an extraordinary degree of tensile strength or cohesion, that in setting it neither contracts nor expands, and that it may be stored in barrels in a dry situation for many months without suffering any deterioration beyond the simple circumstance that it requires a somewhat longer period to set than if freshly made. But, whether recently manufactured or otherwise, or employed pure or intermixed with proper proportions of sand, this cement has the property of hardening, in the course of time, in a wonderful manner. In confirmation of this statement, I have only to refer to the pavement in some places in London, set therein, in which the cement projects in polished ridges, while the stone adjoining is worn into deep recesses. But a still more striking fact is that paving stone is replaced with advantage by slabs formed of the cement in question, intermixed with sand; and such is the resemblance between the artificial and natural stone that to the uninitiated it is a matter of difficulty to distinguish between them. A few years ago, in a highly interesting paper, read before this Association by Mr. Douglas, that gentleman mentioned some of the advantages of Portland cement. Among these, he observed that a beam composed of it, of 4 inches square, and 14 inches long, on being fixed at one end, bore a weight of 1580 lbs. placed at the other end, thus possessing, as he observed, half the strength of Riga fir timber.

We find in some reference books that a definite degree of cohesion is stated to exist, in ordinary work, between the bricks and mortar, which is usually estimated at about 60 lbs. per square foot; but, to show the error of this, we find in observing houses in a state of demolition, in almost all cases the mortar is actually crumbling to dust, thus clearly proving that no material cohesion exists; and instead of the mortar hardening with time, as it certainly should, if properly prepared, the opposite is the fact, which arises from the indifferent kind of materials used in the first instance; but, as I shall have occasion to show, in order to produce sound work, as much depends on the manipulation as on the materials employed.

The accepted theory of the action of mortar is, that the hydrate of lime possesses a great affinity for the silica composing the sand intermixed therewith, and that in the course of time, by the lime absorbing the carbon from the carbonic acid existing in the atmosphere, it is again converted into the carbonate of lime, similar in nature to that it possessed prior to calcination, which is further assisted in acquiring the desired degree of hardness by the particles of silica in combination therewith. And undoubtedly, when due care is observed in the selection of the materials, particularly when the sand is granulated and clean, with good lime, in the course of time the mortar made with these acquires a stone-like hardness; but when mortar is prepared with loamy sand, or with certain earthy substances, it can neither possess any proper degree of cohesion, nor become hard, simply because the action of the lime is counteracted by the presence of the foreign pernicious substances.

As ocular demonstration is always more forcible than any verbal description, I have prepared a few specimens with Portland cement, in order to illustrate my arguments, which specimens were all made with the same description of cement, but under different circumstances. Thus No. 1 consists of six flat tiles, cemented together *when in a dry state*, which, after being allowed a considerable time to set, on the cement becoming hard, with a slight blow the tiles were easily detached; from which we learn that a very limited degree of cohesion exists between cement or mortar and bricks, stone, or other materials, when the latter are in a dry state.

Now, if the same description of tiles be thoroughly saturated with water at the instant of cementing, a very different result is obtained, as may be observed in specimen No. 2, in which the cement is so intimately incorporated with the other that the tiles actually break before becoming detached. Hence we find that, to obtain perfect cohesion, it is absolutely necessary that the bricks or other material shall be thoroughly saturated at the time of operating.

As a further trial of the adhesion of Portland cement, the specimen No. 3 was prepared. This is simply a cylinder of that material, of about 6 inches long and one square inch in sectional area, and at each end is placed a wire in the form of a hook or eye, which wire is enclosed for a short distance in the cement, and intended for the purpose of testing its cohesive strength. To this was suspended a weight of 112 lbs., without the cement breaking, and how much more it would bear I am unable to say, as I did not possess the facility of testing it; but, confining myself to this limit, and taking the specimen as a basis, we find that Portland cement has a cohesive force or tensile strength of 112 lbs. per square inch, or no less than upwards of seven tons on the square foot, which agrees approximately with the statement of Mr. Douglas already referred to. But according to another statement by that gentleman in the communication mentioned, at the end of 30 days Portland cement possesses the extraordinary tensile strength of 417 lbs., and at the end of two years, 675 lbs. per square inch, or nearly 40 tons per square foot of surface. With this remarkable material at our command, it seems astonishing that the same thickness of walls of houses and tanks adopted many years ago should be still retained, and that Engineers do not avail themselves of the remarkable cohesive strength of Portland cement and other similar materials.

Now, speaking theoretically, and taking the strength of the specimen as a basis, the small tank No. 6, of a thickness of one inch, if made of pure cement, should bear the pressure of a column of water 200 feet high, and this without hooping, or any other external support, and a brick tank of one foot thick, supposing every care to be observed in its structure, would be more reliable than any cast-iron tank, with its bolts, nuts, flanges, and hoops. Briefly, in ordinary constructions, instead of proper importance being attached to the cohesive force of the mortar or cement, a thickness of wall or weight of material is brought to bear against the pressure of the water, which is further aided by the pressure of the ground on the exterior of the tank; but I venture to say that, if proper consideration is given to the cohesion of the cement or mortar, and ordinary care taken to ensure this, then the walls of tanks may be reduced to a considerable degree with a corresponding economy.

I now request your attention to composite tanks, which I believe were first constructed by Mr. V. Wyatt, and from which I will pass to those of concrete.

Originally the sides of composite tanks were formed by an inner and outer wall of brickwork of limited thickness, leaving an intervening annular space, which was gradually filled with concrete as the walls were carried up. Subsequently, improvements were introduced by dispensing with the outer wall, and in its place a moveable frame was adopted to retain the concrete until it became set.

But in neither of these constructions was the concrete intended to retain the water, but simply to give strength to the structure, and, as Mr. Wyatt observed on one occasion, he did not believe for one moment that concrete could be made water-tight, that he had built walls 10 feet thick, and yet the water came through like a sieve.

I may here observe that a system similar to the first mentioned is adopted in some parts of the Continent, for the formation of water and wine tanks—that is, by having an inner and outer wall of stone, with the intervening space filled with hydraulic concrete. When constructing these, in a wall 2 feet thick, with a space for the concrete of about 15 inches wide, the concrete is composed of stones, varying in size from a hen's egg to gravel, with an abundance of hydraulic mortar or cement in a liquid state; and, whenever a quantity of concrete is placed, a man is employed to probe it continually at the sides in order to eject the air, which would otherwise be formed in "pockets," as seen in specimen No. 5. The tanks made as described are often employed to contain wine, and in every respect are successful, and their impermeability is due entirely to the concrete; therefore, I ask, why cannot the same degree of excellence be attained with gasholder-tanks?

To resume my notice, a further progressive step was made by Mr. Douglas, by building a tank entirely of concrete, which he afterwards lined with brickwork, as he observed, "to gratify the eye." In the formation of this tank, the cement was not intended to hold the water, for, as Mr. Douglas said "it would leak like a colander," and so it undoubtedly would if not properly prepared.

The next important achievement to be noticed in the class of tanks under consideration was that erected at the South Metropolitan Gas-Works, in which not a single foot of stone—in the ordinary acceptation of the term—or a single brick, entered into its formation, the whole being constructed entirely of concrete, afterwards rendered on the interior with pure Portland cement; moreover, in the construction of this vessel, puddle was entirely dispensed with. The experiment was one of remarkable boldness on the part of Mr. Livesey, and, on the whole, was successful, and that gentleman has done good service by showing the inutility of puddle, which at one time was considered indispensable, whatever it might cost. In this tank also the concrete was not relied on to retain water.

We now come to the consideration of the construction of tanks, and particularly in the formation of concrete, in which, as I will show, the cement unites the masses of shingle, or ballast, with a degree of success, both as regards cohesion and impermeability, depending entirely on the manner the operations are conducted. I must, however, express my diffidence in venturing assertions in opposition to universal practice, but as our desire is to acquire knowledge, and disseminate it, I am sure that if my remarks are soundly based on facts, the gentleman mentioned will be the first to recognize them at their proper value.

We see every day, in the formation of the foundation of roadways, and other work, the concrete is often prepared in the most careless manner, in which a portion of cement is thrown on the ballast, and on this being wetted, the mass is turned over two or three times, and is then placed in its position; but by these means at least one-half of the ballast never comes in contact with the cement, and it follows that, as *concrete*, that portion is useless, and, of course, prepared in that manner, it must be porous.

But, on the other hand, if the ballast be clean and well wetted, and a sufficiency of cement or mortar gauged or mixed with its proper quantity of water, then, on combining the ballast and cement, and turning them over several times, the cement will percolate throughout the mass, so that no interstices exist; consequently, on setting, the concrete becomes impermeable, and in three or four weeks attains that degree of hardness, that on applying a hammer and chisel the stones frequently split before becoming detached.

A popular error is the opinion that Portland cement, like some others, is injured by the slightest excess of water. This, however, is not correct, as concrete formed with it can be thrown into shallow water, without any material deterioration beyond the small quantity of cement which may be washed out in the operation.

To illustrate an imperfect method of making concrete, specimen No. 4 was prepared with loamy gravel in a dry condition, intermixed with one-third its volume of cement. This breaks with facility, clearly showing that the strength of concrete is impaired by employing dirty concrete, and any carelessness in its preparation. With the same kind of material, and under conditions similar to those observed in making the last specimen, the tank No. 5 was made, and, as you may satisfy yourselves, this system of construction, in the double sense of the term, "will not hold water."

For the purpose of illustrating the means of constructing concrete tanks in a superior manner and impermeable, the specimen No. 6 was

made with all ordinary care with clean granulated sand, well wetted, and intermixed with the gauged cement, as already indicated, the materials being in the same proportions as No. 5. This is filled with water, and, as may be observed, it is completely water-tight without the aid of rendering, or any other means, beyond simply placing the material in a mould. In the absence of the proper appliances, the specimens are very rudely made, the principal object being to present to your notice the effects of different manipulations, and, above all, to prove that concrete can be prepared in such a manner as to be impermeable.

Blocks 7 and 8 were also made in a similar manner as the tank No. 6, the strength and impermeability of which are evident.

Therefore we find that the nature of concrete, both as regards strength and impermeability, depends on the manner it is prepared; and, by the proper admixture of the cement with the ballast, each stone or pebble or piece of brick, is surrounded with the cement, which adheres with the tenacity already stated. But, in the event of an insufficiency of cement, or the presence of dirt, in the first instance, a number of cells are left, through which the water percolates, and, in the latter case, the dirt impairs the action of the cement; and, in the course of time, the former is washed out, leaving a passage for the water. Lastly, as shown, when the brick or stone is not well wetted at the time of working, but little cohesion exists. As already stated, Portland cement hardens with time, and thus a properly constructed tank would, in the course of one or two years, attain the hardness of hard stone; whereas, with indifferent materials, instead of hardening, the reverse is the case, when both strength and impermeability are sacrificed.

And here I may observe, that it may be objected that, in consequence of the limited dimensions of the model (if it may be so termed), it is not exposed to the same pressure as an ordinary tank; but, on the other hand, it should be remembered that it is only 1 inch thick, and, if a comparison be made with large tanks of 40 or 50 feet deep, having their walls 4 or 5 feet thick, if this be duly calculated, it will be found, at least so far as regards their respective dimensions, that the smaller vessel is the more difficult to render impermeable.

With regard to the large proportion of cement employed, this, of course, is necessitated by the smallness of the pebbles and sand; but when ballast is employed varying in size from a hen's egg (or in extensive work still larger stones can be employed) to ordinary gravel, then the quantity of cement will be very materially diminished, and, in some cases, 1-20th part of cement will be sufficient—that is, one yard of cement will be sufficient for 20 yards of concrete.

From the preceding statements, and the specimens before you, we learn that where bricks are laid in a dry state, that, notwithstanding the cement may be of the best, no material cohesion exists between them. But when the bricks are thoroughly saturated with water at the instant of laying them, an incredible degree of cohesion is obtained, and it is to be regretted that advantage is not more generally taken of this property.

We also learn that the strength and impermeability of concrete tanks is mainly dependent on the manipulation, and that if any loam or dirt exists with the sand, or if the ballast be not thoroughly combined with an abundance of cement to fill all the interstices, that a structure of this kind cannot be relied on. But if only ordinary care be observed, concrete can be rendered impermeable for the construction of tanks, and it follows that whenever ballast is available at a cheap rate, concrete tanks may be made with a considerable degree of economy, of course, dependent on the relative prices of ballast and bricks.

Hence, as ballast can be incorporated with cement to form a sound tank, it is evident that brickwork and masonry can be applied with like success. With these, each brick or stone will be required to be embedded in the cement, and to ensure the proper cohesion, it cannot be repeated too often, both should be saturated at the time of working.

I have attempted to explain the extraordinary strength of Portland cement, and to prove that tanks can be constructed without the aid of puddle, and, indeed, in most places on the Continent, that material is not known, and, of course, is not adopted; yet, sound tanks of brick and masonry are to be found in abundance. Puddle was employed in the earliest years of gas lighting, long before Portland cement was discovered; and it would not be creditable to the present generation if they persisted in following the methods introduced 50 years ago, and particularly when such vast advantages are gained, on the score of economy, by the introduction of a more perfect and scientific mode of constructing gasholder-tanks.

Mr. G. Anderson said he would describe a work in which he had been engaged, as bearing upon the question dealt with in the paper just read. He had had a tank to build for gas-works, where the bottom of the ground was a peat bog, the peat lying at an angle of about 30° to the surface of the ground. He could not go down to the level of the peat, and therefore decided to float the tank on the bog, and to build it of concrete in the manner Mr. Livesey had recommended, without a single brick or any masonry. He first dug a vertical channel 9 feet wide all round on the site of the tank, into which he put a bed of concrete, 3 feet thick and 9 feet wide, with a skew back to the face of it. He then put his walls on the back of the concrete. He commenced by putting a layer of timber under the concrete, and began at the side where the turf was deepest, and there made the wall 6 feet higher than at the other side, expecting that it would sink more. After having finished the walls, his next object was to take out the interior, and he intended to form a bottom in the shape of a frustum of a sphere, so that it should be able to support the internal pressure. He feared, however, that the great thrust of this on the walls might split them, and therefore put into the concrete three strong iron hoops, about 5 inches broad by 5-8ths of an inch thick. The first year he only built the walls, and did not form the bottom, but put the materials of which it was to be constructed on the top of the walls, so as to load them, and cause them to sink as much as possible. During that winter they sunk 6 inches lower on one side than the other, and he had to restore the level by putting in more concrete. In doing so, he made the lower side 2 inches higher, expecting that it would still go down again. It not only did that, but sank 2 inches more; in fact, it sank about 15 inches on one side and 10 inches on the other during the course of the year in which it was erected. During the whole of that time, however, it never cracked, and it was now as tight as any tank he ever saw; so much so, indeed, that it overflowed with every shower of rain. The whole of the tank was rendered with cement.

Mr. Smith (Darlington) asked Mr. Anderson whether the wall kept plumb when it sank 15 inches on one side and 10 inches on the other, and, if so, how it was there was no crack.

Mr. Anderson said it did not keep plumb, the whole thing went over slightly as a solid mass. It necessarily went out of plumb, in sinking, perhaps one-half or three-quarters of an inch, and the guide-bars were set accordingly.

Mr. George Livesey (London) said he had listened with great interest to the paper just read, but there were one or two points in which he thought it would be advisable to be somewhat careful. For instance, with regard to the tenacity of cement. According to his experience, it would not do to rely on that to prevent a tank cracking. His tank, to which reference had been made, was 45 feet deep, and 184 feet in diameter. When filled with water to about 30 feet of the top, it remained sound for some months, while the gasholder was being put in; but when it was entirely filled, five or six small cracks took place. Now, if the concrete was possessed of such enormous tenacity as was represented, it was rather astonishing that a thick wall should crack from the top to the bottom with no apparent force to produce such an effect. One would think that it would go off like the report of a gun; but, on the contrary, it seemed as if it parted with perfect ease, and as if there was no tenacity whatever in it. The cracks opened to the extent of about 1-16th of an inch, running from the top nearly to the bottom, and almost vertically, right through the concrete, causing a slight leakage. He had, therefore, come to the conclusion that it was necessary to take extraordinary precautions to back up or support the concrete where puddle was not used. Where puddle was used, the concrete or brickwork was in perfect equilibrium, the puddle being the thing which held the water, whilst the concrete or brickwork held the puddle in its place. Where, however, concrete was employed, and rendered with cement, it was important that it should be thoroughly supported to resist the pressure, the whole of which was exerted on the thin skin of rendering. Unfortunately, the pressure came at a time when the tank was least able to stand it—just after the tank had been constructed, within six or nine months, when the concrete had not had time to harden and develop its full tenacity. The same difficulty had been experienced in France. He had seen a report in the Journal of Gas Lighting, some time back, of a French tank built of concrete, which had cracked in the same way. That tank was backed up with sand, solidly as they thought, but still not with sufficient solidity to prevent all expansion of the concrete, and the result was that it cracked or opened. Water was allowed to pass behind it, and thus its equilibrium was restored. He should be inclined, although he objected to it some time ago, to put iron bands into the concrete, especially in the upper part, where the wall was thinner and the backing was not so solid, to resist any strain which might be put upon it when first built. He had certainly not lost his faith in concrete, but he did not say it was to be used everywhere. If he had no gravel at hand, and bricks were cheap, he should use them, and in like manner he should not dispense with puddle if he were constructing a tank in clay. Where there was no clay, where bricks were dear, and materials for concrete were cheap, there was no question which was the right course to pursue. He did not like puddle at all, and, wherever it was possible, should avoid using it, for he had had a great deal more trouble with puddled tanks than with concrete ones. There was one error in the paper just read which he ought to correct—namely, where it was stated that Mr. Wyatt was the first to construct composite tanks. That was not so; the composite tanks for the Chartered Company were not decided upon until Mr. Docwra showed Mr. Evans the plans of one to be constructed at the South Metropolitan Works on the composite plan. The Chartered Company then decided upon it, though they were thinking of it before. With regard to concrete, any material almost might be used, provided it was clean and free from loam. One of the best things to mix was the useless clinkers from the furnaces. They mixed well with the concrete, and all descriptions of cement had a hold on them which they hardly had on any other materials. These clinkers, therefore, instead of being a drug, might become of great use where building operations were going on.

Mr. Paterson (Cheltenham) said he understood from the paper that the writer did not approve of the ordinary method of mixing concrete in the dry form, but advised that the cement should be mixed with water, and poured over the ballast. That was rather important; but he should never think of doing it in that way.

Mr. Hartley said that was only with reference to certain tanks made abroad for wine.

Mr. Livesey said he was not so much interested in wine tanks as in those of a different description. He understood that Mr. Richards recommended that the ballast should be wetted first, and then the cement applied, but not in a liquid state. That was certainly contrary to all his experience in the matter. The rule was to turn over the materials twice by hand, dry, then to mix the water, and turn over again twice. They also had a further mixing from being put into the barrows and deposited in position. Cement certainly could not be properly mixed with ballast if it were wetted in the first instance.

Mr. Hartley said what Mr. Richards laid more stress on was the wetting of bricks or stone—bricks especially.

Mr. H. Gore (London) said that, having had some experience in the use of concrete, there was one matter which appeared to him to deserve some notice. He understood the writer of the paper to recommend mixing Puzzolana with lime; but he (Mr. Gore) found it was dangerous to use it, especially for a water-retaining tank when in contact with lime. It was to all intents and purposes a volcanic cement, due to the decomposition of certain matter, and when it was used with lime, and exposed to the action of water, after a time it underwent a fresh decomposition; the lime apparently extracted the cementing material, and the tank constructed with the composition became, to a certain extent, a colander. He might say that time was one of the most important elements in judging of the practicability of using concrete. His own experience had been that concrete which required the greatest time to become perfectly solid was that on which the greatest reliance could be placed as to the ultimate result, and this was only a natural consequence, bearing in mind what took place. In the mixing of concrete, certain materials were taken and surrounded with a substance which underwent some chemical change; in this process the water took a new form, entered into combination with these materials, and in proportion as that recrystallization took place, so would perfect cementation result. Therefore the longer time that could be allowed for the process, the more perfect would be the result. The experiments referred to entirely bore out that view. It was shown that if a number of dry bricks were put together with cement, crystalline action did not go on, simply because there was no permeation of the water of crystallization with the minute particles of cementing material; but if the brick was immersed in water, all its pores were in a condition to absorb the cement, and thus the effect was produced which was so essential for a permanent solid tank.

Mr. H. P. Stephenson (London) remarked that his experience in the use of Puzzolana differed entirely from that mentioned by Mr. Gore. When engaged, many years ago, on the Sunderland Dock, he used it very largely indeed, and found that it became as hard as a stone. It was used in connection with blue lias lime and sand, and the mortar to the present day stood as well as the day after it was set. On the general question, he thought Mr. Livesey had summed up the matter very carefully, with one omission—namely, that concrete tanks ought to be carried out by very careful workmen, and under a very careful Engineer. If these points were attended to, they might be safely adopted.

Mr. Hunter (Salford) wished to say one word to justify a work in which he was himself engaged. He understood the writer of the paper to regret that Engineers of the present day were still following the lines of 50 years ago in the mode of constructing tanks, and to express an opinion that the antiquated method of building them with bricks and puddle ought no longer to be continued. He (Mr. Hunter) was at present constructing a

very large tank on that old-fashioned plan, simply because, while he altogether agreed with what had been said about concrete, he could, under the circumstances in which he was placed, build a brick and puddled tank much cheaper than if he used concrete, because he was building upon a bed of clay.

Mr. WARNER (South Shields) said that at the mouth of the Tyne immense quantities of concrete blocks were manufactured, generally measuring about 10 by 6 by 4 feet. The arrangement in use there was to employ, in the construction of these blocks, a cylinder with two sides cut off, which cylinder was hung by a travelling crane above the moulds, into which the concrete was allowed to fall. The materials were placed in the cylinder, and four men, by means of a winch-handle, turned it round so many times, and then opened a door, through which it fell into the mould. He had used a similar arrangement for some time; but, instead of a winch-handle, he placed a drum on the cylinder, round which a rope was wound, and a horse attached to it, so that the motion of the horse rotated the cylinder.

Mr. MEAD (Sutton) said that when Mr. G. Livesey read his paper, some time ago, on concrete tanks, he stated, in answer to the writer, that he preferred the old-fashioned practice of puddling. Since then he had had some experience with a concrete tank, 102 feet in diameter, built something on the same kind of site as that described by Mr. Anderson, being on the side of a hill, and on very bad boggy ground. The Engineer who designed it, endeavoured to support it by building some strong piers against the weak side of the tank, but soon after it was built the water managed to get underneath, and came through at the rate of 3 feet in 24 hours. That mischief was remedied, and the tank filled again, but the next thing that happened was that it cracked close by the side of the pier, the crack descending to 5 feet from the bottom, which allowed the water gradually to run away to that level. On a former occasion he had stated his objections to building iron hoops into concrete, because he thought they would expand and crack the concrete, and he then suggested that a hoop round the outside would be the better plan. He was now going to try that, and, if successful, he would state the result at the next meeting. He believed that if the tank referred to had been built on the old-fashioned plan, it would be sound now.

Mr. HUNT (Birmingham) said he gathered that Mr. Livesey attributed the cracks in his concrete tank to the water pressing on the inside. He should like to ask him what depth below the coping the cracks occurred, and whether he estimated the pressure caused by the water inside as against the pressure on the outside of the wall. It was important to ascertain whether it was really the pressure which caused these cracks, or the shrinking of the concrete from imperfect mixture.

Mr. LIVESEY said he felt no doubt it was the pressure of the water. He calculated it, and found that, unless the backing was very solid indeed, cracks might be expected to take place. The backing was formed of solid sand, well rammed, but, solid as it was, there was just sufficient elasticity to allow the tank to give a little, which resulted in the cracks. They were very slight, and no inconvenience arose, but still there they were, running from top to bottom.

Mr. H. VEEVERS (Bolton) said he had constructed a large tank 142 feet in diameter and 32 feet deep, without puddle, without cement, and without sand. He did not use cement, because he preferred hydraulic lime, ground with clinkers from the furnaces. It seemed to be the fact that hydraulic lime got stronger the longer it was left, whereas cement stopped at a certain point, when it took the formation of stone, and if it cracked, it would crack like stone. To avoid the walls cracking, he was careful to back up the brickwork with gravel thoroughly soaked with water. He was much struck with the remark of Mr. Stephenson that a concrete tank required very great care, because he did not think it required any more care than a puddled tank. If a puddled tank leaked in the slightest degree, there was a tendency for the puddle to get washed away, and the hole to get larger; but in the case of a cement or hydraulic lime tank, the fissure would get blocked up, and would not be aggravated by constant washing away.

Mr. HARTLEY, in reply to previous speakers, said he was sure Mr. Richards would be pleased to find what an interesting discussion his paper had given rise to. The substance of the paper was that, in making concrete tanks, great care should be exercised in the mixing of the materials and in the construction. He thought Mr. Hunter was under some misapprehension as to the signification of the expression used, and that the writer did not intend any reflection on Engineers who used puddle, but rather suggested that, in many cases, Portland cement might be used with advantage, and puddle dispensed with.

The PRESIDENT said he had been sometimes struck with the fact that year by year the same matters were brought up for discussion at the meetings of the Association, and did not seem to be definitely settled. This appeared to be the case this year, inasmuch as the remarks made by Mr. Livesey pointed clearly to the fact that in some situations one system might be the very best possible, whilst it would be utterly inapplicable in another. As to constructing a tank without puddle, he should like to repeat the opinion he had already expressed more than once, that where puddle was to be had at all it was very undesirable to omit it. In the case of the cracks referred to, as appearing in concrete, he thought they were more likely to be due to a slight contraction which took place in the drying, than to the pressure exerted by the water. He said this with great deference, but he founded it on this fact, that observing the walls of the Victoria Docks extension recently, he found that although they were of great thickness—22 feet or 23 feet—yet at about every 100 yards there regularly occurred a crack from the front to the back throughout the mass, although there was no pressure upon them whatever. This must clearly have been due to some slight contraction in the body of the concrete, and for this reason he thought that, in the construction of tanks, where puddle was to be obtained, it was desirable to use it. The things to be opposed to each other were brick and concrete, or puddle and rendering, and he perfectly agreed with Mr. Stephenson that it was necessary, where concrete was used—especially where layer came on layer—to exercise the most minute and careful attention to the work in its progress. There was one point mentioned in the paper which was well worth the time devoted to it—namely, the necessity for saturating the materials with which the work was done, whether bricks or ballast, for making concrete thoroughly with water before they were incorporated together.

Mr. ALFRED PENNY (London) read a paper on the

TRANSFER OF GAS-WORKS.

It may possibly be considered that the subject of the paper now about to be read is somewhat foreign to the main objects of this Society, but the matter has of late assumed such large proportions, and the transfer of gas undertakings to Local Authorities has been of such frequent occurrence, that it has been considered by the Council to be a fit subject for discussion by the members of this Association.

It may fairly be asked, why should an industrial undertaking, such as the manufacture and sale of gas, which has been established by private individuals, for the supply of a public want, at their own cost and risk, be subject to interruption and control by Public Authorities of any kind? The answer is, that the distribution of gas involves an interference with the Queen's highway, and a breaking up of streets and pavements, which cannot be done legally without the authority of Parliament; and, although many small Companies carry on their operations without statutory powers, it is well understood that this is done at considerable risk and disadvantage to the Gas Company, if, as frequently happens, any differences should arise between them and the Local Authority of the district.

It is worthy of remark that there are but few instances of a Public Authority having established gas-works for themselves, Manchester being one of the few towns that have done so.

As a matter of history, it is well known that when gas lighting was first introduced into England, the profits upon the capital invested were generally very small, and sometimes absolutely *nil*.

At that time, therefore, no disposition was felt by Local Authorities to acquire the gas undertakings supplying their districts, and it was only when these undertakings began to be profitable, that the possession of them was coveted by the public bodies, who had, as a rule, done nothing to aid or assist them in their early struggles.

As the value of gas as an artificial light became more fully appreciated, and its use extended, the returns upon the capital invested increased in a like ratio, and gas undertakings began to take rank as a solid and permanent investment for capital.

Then commenced the attacks upon Gas Companies whose operations had become sufficiently prosperous to tempt the cupidity of Local Authorities.

These attacks took various forms; sometimes it was a clamour about price, sometimes about quality, and an alleged insufficient supply; but it invariably led up to the real object, which was a desire to become the owners of a profitable undertaking.

Fortunately, this object could not be attained without the assistance and consent of Parliament, who very early made it understood that they would lend no countenance to schemes which involved something like a confiscation of vested rights.

Many attempts were made to acquire gas undertakings compulsorily, but all ended in failure; and whenever Parliament were asked to confer upon Local Authorities statutory powers to acquire and hold a gas undertaking, or to erect works in competition, these powers were never granted until after they had agreed to purchase, at its commercial value, the undertaking of the Gas Company whose district they desired to supply.

The plea put forward in justification of these attempts was the public good, it being contended that the supply of gas ought to be in the hands of Public Authorities, because its distribution involved interference with the roads and streets, which were under the control of the said authorities; and that the profit made by the Gas Companies, and divided among their Shareholders, ought to be made available to pay for public improvements, or to diminish rates.

It was also contended that after a Company had succeeded in making a profit sufficient to pay their maximum dividends, that they had no longer any motive for economical working, and that to avoid reducing the price of gas, and for the purpose of employing capital, they would make unprofitable extensions, and also pay large salaries to their managers and *employés*.

This is a fair sample of the allegations made against Gas Companies by Local Authorities when attempting to get possession of their undertaking.

It will be, I think, quite unnecessary for me to deal with these statements at any length; but having had a tolerably large experience in the examination and dissection of Gas Companies accounts—sometimes in rating cases, sometimes in connection with applications to Parliament for statutory powers, and also as the professional adviser of many Gas Companies—I am enabled to say that these statements are, as a rule, incorrect, and not capable of proof.

My own experience is that, however prosperous a Company may be, the Directors invariably use their best exertions to buy everything required for the purposes of the Company at the lowest possible rate, and certainly, as a body, they have not exposed themselves to the charge of paying their officers too liberally; on the contrary, it is my deliberate opinion that they too often err in the opposite direction, and, having regard to the positions of trust and responsibility held by the Managers of gas-works, they are, as a rule, insufficiently remunerated for the valuable services they render, and there is, consequently, no saving that can be made by public bodies in either of the above cases.

The one solitary advantage a Public Body would have over a Company would be in the lower rate at which they would raise money for the extension of the undertaking, as compared with the authorized dividends of the Company upon their share capital; but, as I shall presently show, even this has ceased to exist.

It is, perhaps, fair to state that the transfer of gas-works in some large towns has been precipitated, if not actually brought about, by the dissentions of rival Companies, and the disregard of true economical principles exhibited by them in the conduct of their undertakings; and, notwithstanding the *ad captandum* argument that competition *must* be of advantage to the consumers of gas, the public were not slow to perceive that a duplication of main-pipes through every street, with the attendant annoyance and cost caused by breaking up the roads, besides the expense of a double staff, with rival Boards of Directors, &c., could not, in the long run, be to their advantage.

In some of these cases the Companies concerned were wise enough to amalgamate; but in others, where party feeling was too strong, legislative pressure was brought to bear upon them, and the undertakings passed into the hands of the Local Authorities.

This state of things has, however, long ceased to exist, as Parliament have permanently recognized the fact, that it is for the true interests of the public that Gas Companies should *not* be allowed to compete with each other; but should, in the interests of the public, be placed under proper legislative restrictions, and become, in fact, regulated monopolies.

By the recognition of these principles, and by agreeing to abandon competition, and by districting their respective undertakings in 1860, the great London Companies have been enabled to hold their own, and to bid defiance to all attempts of the Public Authorities of the Metropolis to take from them the conduct of their various undertakings.

I will now speak of the effects of modern legislation upon the interests of Gas Companies, as bearing upon the question of the transfer of gas undertakings to Local Authorities.

By section 56 of the Companies Clauses Consolidation Act, 1845, a Gas Company having, under the powers of a special Act, raised capital partly by shares and partly by loans, were entitled, with the consent of the Shareholders, to create additional shares at par, and to pay off the loans—to turn their borrowed money into share capital.

This valuable privilege has now been withdrawn from Gas Companies, as Lord Redesdale insists upon a special clause being inserted in every Gas Bill, which prohibits any such dealing with that portion of the capital authorized to be raised by loans, except on the condition that shares so created should bear a dividend of not more than 5 per cent.

And by clause 58 of the same Act, any new shares created under the powers of the special Act of the Company were "to be apportioned

amongst the then Shareholders in proportion to the existing shares held by them respectively."

I need hardly state that this is now a thing of the past. The Standing Orders of last session, which made it compulsory upon all Gas Companies applying to Parliament, either for a new special Act of Incorporation, or for additional powers, to insert what are known as the "auction clauses" in their Bills, have withdrawn from statutory Companies one of their most valuable rights.

The concurrent introduction of a standard price and a sliding scale is doubtless some alleviation; but, in practice, I think it will be found that but few Companies will be in a position to avail themselves of its advantages.

The effect of all this is, in my judgment, to take from the Shareholders of Gas Companies all pecuniary interest in the future extension of their operations.

We will now turn to the Gas Works Clauses Act, 1847.

By section 30 a limitation of 10 per cent. per annum is placed upon the profit allowed to be divided by the Company upon their original paid-up share capital.

Section 31 is of so much importance for my argument, that I make no apology for transcribing it entire:—

"If the clear profits of an undertaking in any year amount to a larger sum than is sufficient, after making up the deficiency in the dividends of any previous year as aforesaid, to make a dividend at the prescribed rate, the excess beyond the sum necessary for such purpose shall from time to time be invested in Government or other securities; and the dividends and interest arising from such securities shall also be invested in the same or like securities, in order that the same may accumulate at compound interest until the fund so formed amounts to the prescribed sum, or if no sum be prescribed a sum equal to one-tenth of the nominal capital of the undertakers, which sum shall form a reserve-fund to answer any deficiency which may at any time happen in the amount of divisible profits, or to meet any extraordinary claim or demand which may at any time arise against the undertakers; and if such fund be at any time reduced, it may thereafter be again restored to the said sum, and so from time to time as often as such reduction shall happen."

Section 33 provides that when the reserve-fund is full, the interest thereon shall be dealt with as part of the profits of the undertaking.

Section 34 provides that the reserve-fund may be used to supplement the profits in any year where sufficient has not been earned to provide the prescribed rate of dividend.

Section 35 provides that if there be any profit in excess of what is required to pay the prescribed dividend, and if the whole of the reserve-fund has been, and remains, invested, that the price of gas shall then be reduced, &c.

It is quite clear, from the above, that the establishment of a reserve-fund has been sanctioned, if not prescribed, by the Legislature, and that all Gas Companies, with statutory powers, are entitled, if they think proper, to fill up their reserve-fund *before reducing the price of gas*.

In practice, however, this is not commonly done, and very few Companies have any reserve-fund at all within the meaning of the Act—*i.e., properly invested*. In most cases, undivided profits are invested in extensions of the works and plant, and are made to do the work of capital to the great benefit of the consumers.

But having regard to the fact that circumstances may arise at any time which may make it advisable or necessary for a Gas Company to part with their undertaking to a Local Authority, I wish to point out that it is the interest of all Gas Companies, before unduly reducing the price of gas, to fill up their reserve-funds, to have their plant in the highest state of efficiency, and to keep their accounts in the clearest manner.

It is useless to attempt to hide the fact that, from various causes, the control of gas and water works is passing into the hands of public bodies, and it is well that the matter be looked at full in the face, that all parties should understand how their interests will be affected, and how those interests may be best protected.

By the introduction of "auction clauses" into all Gas Bills, and the extinction thereby of the rights of Shareholders to take new capital at par, their interest in maintaining possession of their undertakings has been sensibly weakened, and, consequently, there is no reason to suppose that the process of "transfer," which has already assumed such formidable proportions, will have less force in the future than it has had in the past.

So far as the interests are concerned of the gentlemen whom I have now the honour to address, I fear they may not be better off under the new *régime* than under the existing one, but it is possible that the gas consumers may find themselves anything but benefited by the change.

The result of many recent arbitrations to settle the value of gas undertakings has been conclusively to show that a Gas Company, earning full statutory dividends, will obtain not less than 25 years purchase of same; in other words, that the purchasing body will be able only to get 4 per cent. upon the purchase-money of the existing business.

In some recent cases of transfer, where there has been an invested reserve-fund, it has been, by arrangement, retained by the sellers, and as the ambition of the Local Authority purchasing is usually to show a large profit on the working of the concern, the experience in the past has been that this result is arrived at, for the most part, by maintaining the price of gas at a higher level than would have been possible, or necessary, if the undertaking had remained in the hands of a Company controlled in their operations by section 35 of the Gas-Works Clauses Act, the restrictions contained in which have never yet been imposed upon a public body having authority to supply gas, who are at liberty to make any profit they can, so long as they charge no higher price for gas than the maximum price named in their Act, or in that of the Company of whose undertaking they have become possessed.

It is quite clear, therefore, that gas consumers may, by this means, be taxed for the benefit of those ratepayers who are not gas consumers.

The foregoing observations are principally directed to the case of those Gas Companies having statutory powers; but there are many instances of Local Boards, in growing districts, attempting to acquire the control of the gas supply in their respective localities, where the Gas Company are not protected by a special Act.

I need hardly point out that in such cases the non-statutory Company are at a great disadvantage, and, in fact, have no option but at once to go to Parliament for an Act of Incorporation, because, under the powers of the Public Health Act, 1875, section 161, any Urban Authority, where there is no company or person *authorized by Parliament* to supply gas for public or private purposes, may themselves undertake the supply of gas throughout the whole or any part of their district; that is to say, a non-statutory Company whose operations are not protected by a special Act or by a Provisional Order, confirmed by Parliament, are very much at the mercy of the Local Authority desiring to acquire the gas undertaking.

Very exaggerated notions of the burthens which the cost of an Act would entail upon a small Company prevail, but experience has shown that the benefits far outweigh the cost.

There are numerous Companies, with a sale of from 6 to 12 millions, without statutory powers. If a Special Act costs say £800, taking the sale of the smaller quantity, the cost of the Act would only entail an additional charge of about 1½d. per 1000 cubic feet, and for the larger quantity about ¾d., while the possession of the Act will not only be a source of strength in dealing with the Local Authority—the operations being protected by Statute—but will absolutely enhance the value of the undertaking for sale, to a greater extent than the sum expended in obtaining it.

I therefore strongly advise small Companies *without* statutory powers seriously to consider this question in connection with the subject of probable or possible transfers in the future, and to protect their property in the way I have indicated.

I will now bring this paper to a close, and while I am quite sensible that the information it contains is already well known to many gentlemen now present, yet there are doubtless others to whom it may be useful.

I have no other motive in bringing before the meeting the subject of this paper except that I may add my mite to the mass of valuable information which has been gradually accumulating since this Association has been established, and will only say, in conclusion, that whether the gas-works of Great Britain remain in the hands of private companies, or pass into the possession of public bodies, it is quite certain that there will never be a lack of able and honourable men, with the necessary scientific knowledge and skill, to carry them on with advantage to the public and credit to themselves.

Mr. H. P. Stephenson said it was very curious that in the parliamentary arrangements made with regard to Gas Companies, the authorities were very careful that in Gas Companies Bills stringent clauses should be inserted, defining very exactly the powers conferred; but when public bodies themselves went to Parliament they never said anything whatever about these things. They seemed to think they were such virtuous, honest individuals that all these matters might be left to their own honour. What struck him in connection with the paper just read was this—that, if some small Companies went to Parliament to get an Act, with a view to afterwards transferring their undertakings to the Local Authorities, they might have such disagreeable provisions included in their Acts that the Local Authorities would not have anything whatever to do with them.

Mr. Sheppard (Horsham) said there was one point which might affect the interest of many members present. It would be found in the Public Health Act that, when a Local Governing Body purchased a statutory Company, they were required to make remuneration to the officers. He would, therefore, suggest to those present, if they happened to belong to non-statutory Companies, that they should use every endeavour to induce their Directors and Shareholders to get incorporated.

Mr. Storer (Stafford) desired to thank Mr. Penny for his admirable paper, and only regretted that it had not been read several years ago. Had it been, it would have given information to many Gas Managers, which would have proved very useful to them. Had his Company possessed the information some few years ago which he had been in possession of some few months, the Stafford Gas-Works would never have been transferred to the Corporation at the price they were, although the price obtained was nearly 30 years purchase of the dividend; and it was a compulsory sale too, which was about as high a price as that of any gas-works which had been transferred. Looking at the tendency of things in the present day, he would advise his brethren to put their houses in order, and have all the apparatus connected with their works thoroughly up to the mark; to let everything be done as well as it possibly could be done; to fill up the reserve-fund; and, amongst other things, if the Corporation had not already an Act by which they had power to purchase the works, to carefully watch that Act when it was being obtained. The Act at Stafford, under which the Corporation obtained the power, was unfortunately not watched. He would not say whose fault it was, because the party was not present; the consequence was, a clause was inserted which was never noticed until about a week ago, the effect of which was that the whole of the purchase-money must be equally and rateably divided amongst the Shareholders, without any provision being made for the compensation of Directors or officers. The transfer did not take place without going to arbitration. Some of the most eminent men of the day examined the works, and under the arbitration certain awards were made. Amongst other things, were certain sums allotted for the Secretary and for Directors; but he was sorry to say that, in consequence of the clause mentioned, all those allowances had vanished, and the Directors found themselves obliged to pay over every penny of the purchase-money to the Shareholders. Fortunately it was discovered that the Company had not paid their full dividends for a certain time, and they were able to capitalize the interest on the debenture stock which had been borrowed at from 4½ to 8 per cent., or else they would have been handed over, tied hand and foot, at 25 years purchase.

Mr. Carr (Halifax) rather regretted the tone that some of these discussions took with regard to Corporations. He had made a similar remark at the last meeting, and as so many Members of the Association now represented Corporations, it was only fair that some one should take the Corporation side in these questions. He for one thought a great deal more was said about Corporations than was altogether justified. Of course, there were some Corporations whom no one admired, and, judging by the way in which some Companies rewarded their servants, none of them would like to be in similar institutions. But he had had experience of some Companies who did not do exactly as they ought to do, or as they considered a Company ought to do, just as there were some Corporations who did not exactly do what they would like. It struck him that if the Members of the Association were to follow out the President's suggestion, and make a report to their respective committees when they went back, and had to state that the meeting had been engaged in pitching into Corporations, and showing them up in the most deplorable light, these bodies might be induced to reconsider the question whether they would allow their Engineers to come to these meetings. He was quite certain that many of these reports got into the hands of Corporations, and he could not think that the members of those bodies who read them would be favourably impressed by what they read as coming from the mouths of their servants when they assembled together. Some gentlemen objected to his remarks, but he was not speaking so much about anything which had been said that day, but was rather drawing a strong case of what he desired to avoid. He thought they should try to make the Association as representative as possible, not of gas companies, but of the engineering profession; and he was sorry to see that the Journal of Gas Lighting took a one-sided view of this matter—even going the length of questioning whether any man of honour could serve a Corporation. He thought those remarks were to be deplored. They did not improve the position of those gentlemen who did serve Corporations, and he was quite sure they did harm.

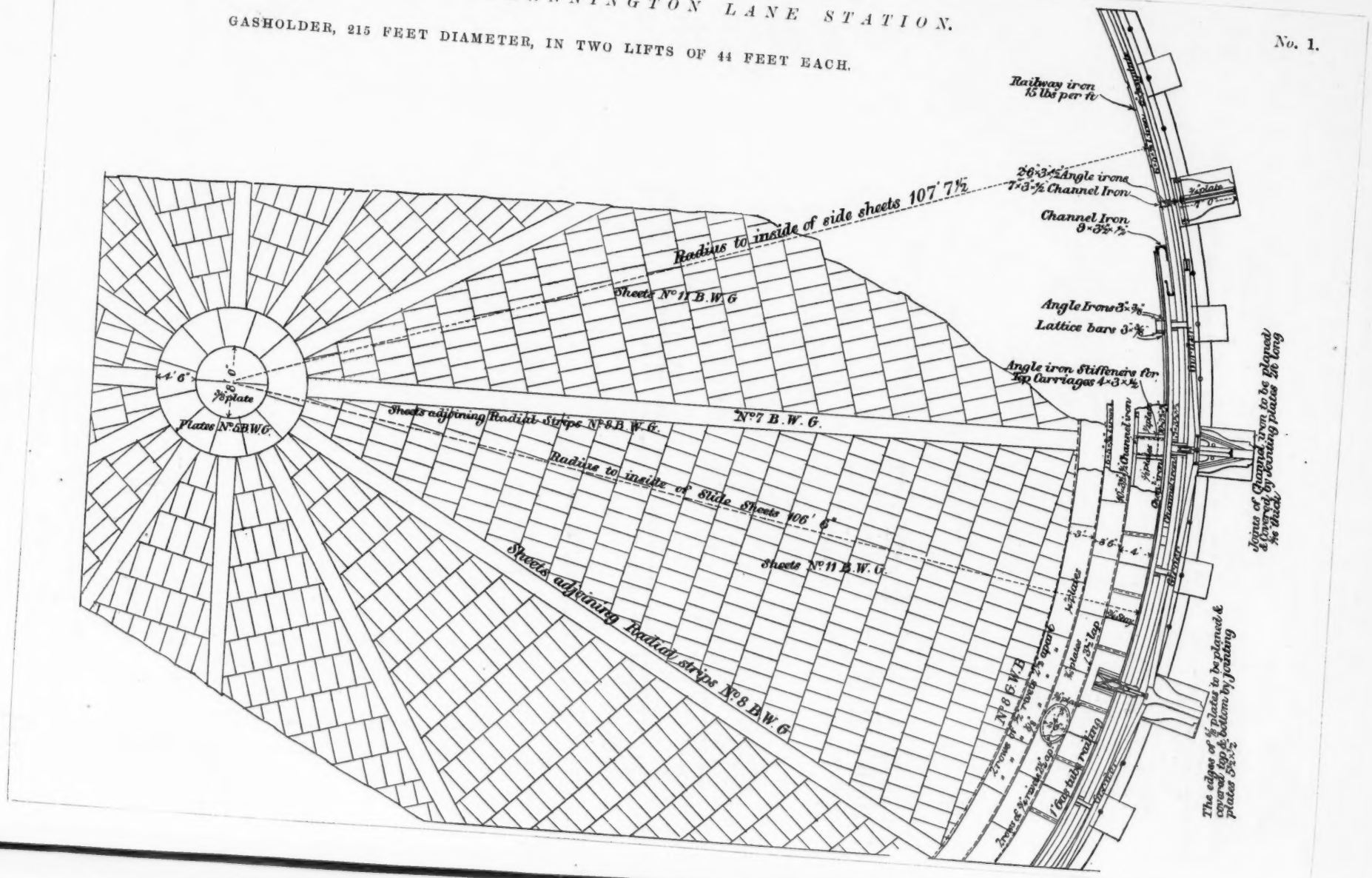
The President, interposing, said the discussion of remarks which appeared in the Journal of Gas Lighting was hardly pertinent to the question.

Mr. Carr said he would, of course, bow to the decision of the Chairman. There were one or two remarks in the paper which seemed to him rather contradictory. One was that Gas Companies invariably did the best they could, independent of any pecuniary benefit it might be to the consumers. Then, in deploring the action of auction clauses, Mr. Penny went on to say that the effect was to take away any pecuniary benefit the Company

PHŒNIX GAS COMPANY—KENNINGTON LANE STATION.

GASHOLDER, 215 FEET DIAMETER, IN TWO LIFTS OF 44 FEET EACH.

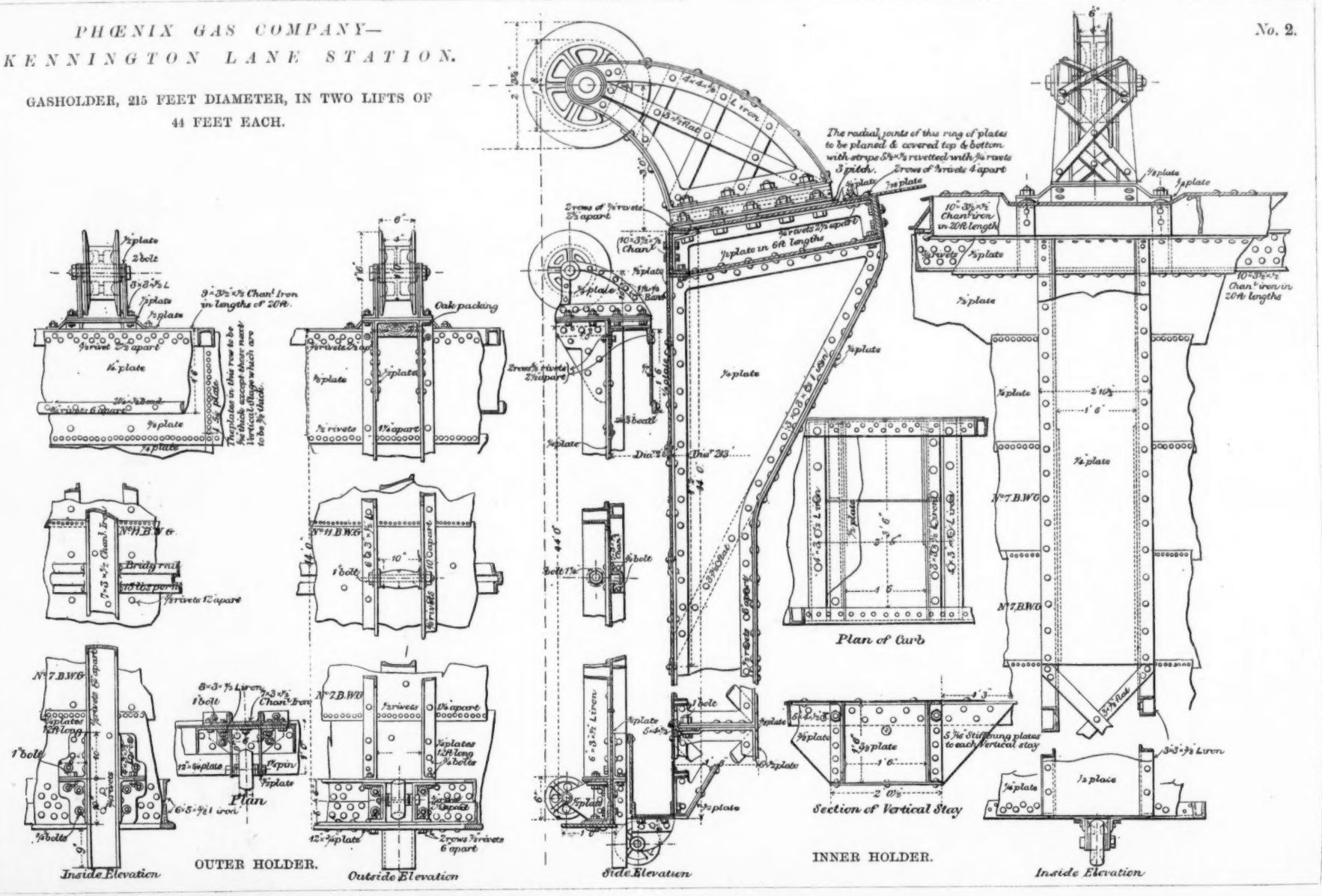
No. 1.


Railway iron 15 lbs per ft
26×3½ Angle irons
7×3½ Channel Iron
Channel Iron 9×3½
Angle Irons 3×3
Lattice bars 3×⅜
Angle iron Stiffeners for Top Carriages 4×3×½
Radius to inside of side sheets 107' 7½"
Sheets N°11 B.W.G
Sheets adjoining Radial Strips N°8 B.W.G.
N°7 B.W.G.
Radius to inside of Side Sheets 106' 6"
Sheets N°11 B.W.G.
Sheets adjoining Radial strips N°8 B.W.G.
Plates N°5 B.W.G.
4' 6"
6"
⅜ plate
N°8 B.W.G.
Joints of Channel iron to be planed & covered by Cover plate 2ft long ⅜ thick, & Cover plate 2ft long
The edges of ½ plates to be planed & opposite top & bottom by Jointing plates 5½×½

No. 2.

PHŒNIX GAS COMPANY—
KENNINGTON LANE STATION.

GASHOLDER, 215 FEET DIAMETER, IN TWO LIFTS OF 44 FEET EACH.


The radial joints of this ring of plates to be planed & covered top & bottom with strips 5⅞×⅜ riveted with ⅞ rivets 3 pitch. 2 rows of ⅞ rivets 4 apart
Plan of Curb
Section of Vertical Stay
Inside Elevation
OUTER HOLDER.
Outside Elevation
Side Elevation
INNER HOLDER.
Inside Elevation
Plan

might have from the proper regulation of their business. These two things did not go very well together. He was not exactly of the opinion expressed with regard to the auction clauses. He thought 10 per cent. was a very high sum to be guaranteed by Parliament as the return for money *to be* invested, though it was not at all too high for money which had been invested under risks which did not now exist. Seeing that the risks had all been removed by Parliament, he did not see that so high an interest was required for money which had to be invested in future.

Mr. HELPS (Bath) said they must all be thankful to Mr. Penny for his interesting paper regarding the transfer of gas-works to Corporations. He would suggest that some member should read a paper next year on the other side of the question—namely, the transfer of gas-works from Corporations to Companies.

Mr. WOODALL (Leeds) said he had occupied for some time the exceptional position of being in favour of the transfer of gas-works to Corporations. At Leeds the Corporation were doing all that any Company could be supposed to do in the interest of the gas consumer, and the line of policy they pursued was the very opposite to that which Corporations ordinarily followed. When he went to Leeds he found a deficit of something like £20,000, due from the gas undertaking to the borough fund, and until they had paid that, the Corporation did not feel justified in dealing with the profits as belonging to the consumers. But that amount once paid off, he propounded the principle of "gas profits for gas consumers," and, somewhat to his surprise, he had very little difficulty in permeating the whole Corporation with his view on the subject. From that time the Committee had gone to the extreme in that direction. They did not even wait for a balance in order to be assured that they might sell gas at a lower price in the year following, but they anticipated the balance which was to accrue, supposing the price were maintained, and he had his instructions each year to prepare an estimate in such a way that no balance should remain. In fact, it would be best work on his part to make the income and expenditure exactly balance, and not allow of one penny being paid even for income-tax. But while he favoured this principle of the transfer to Corporations, he did not see that much good could result to any parties, now that auction clauses were introduced into all new Acts, because under the auction clauses, a Company would in future erect additional works at a cost of 5 per cent., whereas a Corporation must pay 4, or 4½, or perhaps 4¾ per cent. for money they required to raise; and they must put by, for a sinking-fund, perhaps 1 per cent., so that the charge for the future gas business of Corporations would be quite as large as if the business were managed by Companies.

Mr. PENNY said there was not a great deal to reply to. Mr. Woodall had made some apposite remarks; but he thought the line of conduct adopted by the Corporation of Leeds was an exception to the rule. His own opinion was that, when Local Authorities acquired gas-works, they did it with a view of obtaining profits for some general purpose. No doubt the idea was that it would be a benefit to the township; but as it happened, the profits so obtained were provided by the gas consumers, so that those who were not gas consumers received a benefit they were not entitled to. However this might be, he did not consider that his observations on Local Authorities and Corporations were obnoxious to the remarks made by Mr. Carr. This gentleman overlooked the fact that Local Authorities first attacked Gas Companies, with a view to get possession of their property. He (Mr. Penny) had certainly not said much to the detriment of Corporations in respect of their conduct of gas undertakings; but, all the same, he believed their management was not superior to that of the Companies whom they superseded, nor did he think, if his paper were read carefully, it would be considered by Corporations that their officers had been placed in a false or improper position by merely listening to its contents. What Mr. Storer had said was much to the point—viz., that it was necessary for Gas Companies, and those who advised them, to be very careful in the conduct of their operations, having regard to what might possibly happen. The mischief in Mr. Storer's particular case was done long before the arbitration commenced, and could not be undone by those acting for the Company at the time the arbitration was being held. So far as he could gather, those whose duty it was to watch the Stafford Corporation Bill watched it at a distance, and so did not see those obnoxious clauses which bore so hardly on the officers of the Stafford Gas Company. There was no doubt that when a Gas Company were about to be transferred, it was advisible, if possible, that the interests of those who had been serving them so many years should be studied. He should, therefore, strongly recommend the Directors and Officers of Gas Companies, when a transfer of their undertaking was in contemplation, not to wait until the mischief was done, but at once consult those competent to advise them, who were constantly engaged in parliamentary business, and knew what the meaning of those little clauses were, which appeared simple in themselves, but which sometimes had very serious consequences when they came to be inquired into and acted upon.

The PRESIDENT, in closing the discussion, said he was quite sure the whole body of members would support Mr. Carr in the observations he had made, but he was not aware that, either in the present discussion or any other when he had been present, anything had been uttered to which exception could be taken.

Mr. GEORGE LIVESEY read the following paper on

CAPITAL AND REVENUE.

"The Proportionate Capacity of Apparatus and Standards for Capital and Expenditure" is one of the suggested titles for a paper, and although it appears a very practical subject, it will probably be found, on further consideration, an exceedingly difficult one to deal with satisfactorily. The first part, relating to the proportionate capacity of apparatus, would probably be answered in the best manner if a return could be obtained from a sufficient number of the members of the Association to be fully representative of all the varied circumstances under which gas undertakings exist, setting forth the capacity and the cost of construction of the retort-houses, condensers, washers, scrubbers, purifiers, gasholders, and mains. An individual can give only his own experience, which certainly could not be accepted as a reliable standard for all gas-works, seeing that no two can be exactly alike.

In reference to capital, which is the chief subject of this paper, it ought to be possible to find a maximum standard, in proportion to gas-producing power, which shall be capable of application to all except the smallest works.

The relation of capital to revenue is, in principle, a simple matter, but in our business it is complicated by such a variety of circumstances and interests that a great confusion of opinion and of practice has resulted.

Capital may be defined as money represented by productive works, or used in working a business; there is a vast amount of so-called capital which is unfortunately represented by nothing at all. To begin with, we have the National Debt, which represents nothing but the good faith of the country, and its ability to pay, not its debt, but merely the interest; but the debt is not capital representing actual property. Again, there is an enormous amount which goes by the name of capital, although it stands for nothing but money spent in fruitless contests, in waste of various kinds, mistakes and extravagance on works that are obsolete or worn out, and on works that now have no existence.

This does not apply to gas-works merely, but to railways, docks, water-works, and to joint-stock enterprises generally. So long as a concern is able to pay interest on its nominal capital, it is assumed that the capital is represented, and it has a market value; but I hold that the only sound position is that the works and plant should be fully worth, at all times, the sum charged against them in the capital account. It is quite true that capital may, nay, must be expended, and with perfect fairness on other things than plant. For instance, the cost of an Act of Parliament, or the *legitimate* expenses attending the starting of an undertaking, or the amount paid for a foreign concession, are all proper charges on capital; but a sinking-fund must be provided out of revenue to liquidate the cost of the concession by the time that it expires. Preliminary expenses also should be written off as soon as possible, and even the cost of an Act of Parliament. Although the powers conferred by it may be exceedingly valuable, present and prospective, still, changes being possible that may render an Act of Parliament valueless, the capital account should be cleared of this charge also, in order ultimately to attain the position of having every penny of capital fully represented by the structural value of productive works.

This may be said to be a mere truism, and in the case of the individual millowner, manufacturer, or shipowner, it must be accepted and acted upon, or he will sooner or later find himself in difficulties. The principle is recognized and put into practice by the great Steamship Companies, and there is, I suppose, at least one English Gas Company, whose works are all on the Continent, and one or two Companies with works in England, where the value of the plant *exceeds* the amount of the paid-up capital. But these are exceptional cases, and not recommended for imitation; they are sacrificing, to some extent, the interests of the existing Shareholders for the benefit of posterity, or for the public body that may purchase their undertaking. They have, however, as yet, found scarcely any imitators, the overwhelming majority erring in the opposite direction at the expense of future generations of Shareholders or of the Public Authorities who may be tempted to purchase.

In many cases the disparity between the value of the works and the interest-bearing capital would, if the business were not of an exceptional character, be simply ruinous. Where would an ordinary manufacturer, exposed to fair competition, find himself if his plant for making a certain article had cost just double as much as other makers had expended on similar plant? The question needs no answer.

Having made the statement that gas undertakings generally have a larger capital than is represented by works, it is necessary to bring evidence in support of it, and to name a standard of capital in proportion to gas-producing power that shall be fairly applicable to all ordinary cases, and allow a good margin for unforeseen contingencies. The margin will be somewhat greater in large works, but not so much greater as would appear at first sight. For instance, a retort-house to enclose ten retorts would probably cost less in proportion to the number of the retorts than one to cover 200, seeing that the walls of the small house will be less than half the height and thickness of the large one, and the roof also will cost less. On the other hand, small gasholders cost more in proportion than large ones.

Four years ago, in this room, I said that the capital expenditure on new plant might, in most cases, be kept within £5 per ton of coals used in the year. I am now prepared to say that where the capital exceeds £5 per ton, or, say, 11s. per 1000 feet of gas sold, the capital is greater than the value of the works, mains, and working capital. It is better, perhaps, to take as the unit the 1000 feet sold, rather than the ton of coals used; but if we assume that the unaccounted-for gas does not exceed 10 per cent.—it should be well within that figure—the ton of coals will stand for 9000 feet of gas sold. These terms are easily convertible by dividing the amount per ton by nine; and so, for convenience and simplicity, I shall take the ton of coals as the unit.

Of the total capital, if a Company pay all their accounts in cash when the goods are delivered, nearly 10 per cent., but not exceeding that amount, will be required for working capital; this leaves £4 10s. per ton for plant. It is generally agreed that of the capital expended, about two-thirds will be laid out on the works and land, and one-third on mains, meters, and services. By this rule we obtain out of the £5—

	£	s.	d.
Works per ton of coal	3	0	0
Mains, &c., outside the works	1	10	0
Working capital	0	10	0
Total	5	0	0

Or at per 1000 feet sold it will be—

	£	s.	d.
Works	0	6	8
Mains, &c.	0	3	4
Working capital, about	0	1	0
Total	0	11	0

This statement is based on my own experience in the construction and valuation of works. It is supported by that of eminent engineers with whose work I have become acquainted, who have exceeded in economy, without sacrificing efficiency, anything that I have done.

The item of £1 10s. per ton, or 3s. 4d. per 1000 feet sold, for the outside plant, does not require detailed evidence to prove its sufficiency. I, therefore, proceed to sustain my assertion that £3 per ton, or 6s. 8d. per 1000 feet sold, as applied to the cost of works and land is sufficient, by the following actual cases, the names only being withheld.

It is not contended that the capital account should be exactly divided as above indicated. All that I wish to maintain is, that the £5 per ton, or 11s. per 1000 feet sold, is a sufficient maximum capital for all but very small works.

Case No. 1.—Small works in Yorkshire, complete in every respect, and capable—with a margin of at least 15 per cent. of retorts out of use in the depth of winter—of carbonizing 16 tons of coals per day, or 3200 per annum—say, 3000 tons—which, with a total cost of works and land of £8420, gives £2 16s. per ton of coal, or 6s. 3d. per 1000 feet sold.

Case No. 2.—New works on new site, to replace old worn-out works in a cheap district—North of England. The Company with a heavy capital, and very little to show for it, necessitating great economy. With a little correction, these works can be taken as capable of using 100 tons of coals per day, or 20,000 tons per year; but taking them as constructed, there is a retort-house, to contain retorts sufficient to carbonize 125 tons per day, and to allow more than 10 per cent. out of use. Condensers, exhausters, purifiers, scrubbers, and meter for 100 tons, or 1,000,000 feet per day. Gasholder storeage, 500,000 feet. Cost, inclusive of six acres of land complete, £23,600. Coals used in the year, 9000 tons, equal to £2 12s. 5d. of capital per ton of coal, or 4s. 9d. per 1000 feet sold.

But, by adding another gasholder for 500,000 feet, and setting some additional retorts, the capacity of the works will be brought up to 100 tons per day, or 20,000 tons per year. For these additional works, I add, as the outside cost, £11,000, which is more than they would amount to at the rates at which the other work was executed.

The total, therefore, for 20,000 tons per year will be £34,600, equal to

£1 14s. 7d. of capital for each ton of coal used in the year, or less than 4s. per 1000 feet sold.

Case No. 3.—Some entirely new works, not 100 miles from this place, erected as an additional station for a large Company, calculated to make 3,000,000 a day, corresponding with a consumption of 60,000 tons of coals per annum. Cost complete, with a large plot of land, very little over £100,000, or well within £2 per ton of coal, or 4s. 6d. per 1000 sold.

It is right to add that cases 1 and 2 are in cheap districts, No. 1 being erected at the time when prices were rising, No. 2 in cheap times, and case No. 3 is not in a cheap district; but the work was done, and done thoroughly well, when prices were low.

Case No. 4 is that of a large Company where a large area of land was purchased, some ten or twelve years ago, adjoining the works on which the extensions have been made. This Company have, I know, charged to capital, during the past 12 or 15 years, a sufficient sum to pay for all the outlay on land, works, mains, meters, &c., to meet the requirements of a business that rather more than doubles every ten years, with the result that the proportion of capital to coals used has remained stationary at about £4 15s. of capital to the ton of coal. At the same time the price charged for gas by this Company has, during the whole period, been lower than any of their neighbours. A very large proportion of the additional work was executed during those late years of excessive prices, and the surplus power of the works has been very considerably increased. The gasholder capacity, in 1866, was less than 80 per cent. of the maximum make, and in 1877 it was 115 per cent., while the retort power, with the other portions of the plant, has been increased to a corresponding extent beyond the proportions of ten or twelve years ago.

I do not say that the cost of the works, as set forth in cases 1, 2, and 3, is to be taken as a standard, for I consider that any standard should be based on average prices and circumstances; but these cases, taken in conjunction with case No. 4, fully warrant me in saying that £5 per ton, or 11s. per 1000 feet sold, is a sum that ought not, in any case, for new works, except the very smallest, to be exceeded. Whether or not it is necessary or desirable in all cases to make the effort to reduce existing capitals to this level is not my business to decide. It is a complicated question, and must be settled by those immediately concerned. I only say that any capital exceeding this standard is not represented by works.

That capitals generally exceed this limit is an undoubted fact; but, in order not to appear invidious, I take the London Companies as an example.

In 1861, when the first parliamentary return was made, the aggregate capital of the 13 London Companies was £5,647,899, and the coals used did not exceed, but nearly approached to 644,000 tons. I cannot obtain exact figures, but know that this may be taken as sufficiently correct. This works out to close upon £9 of capital per ton.

In 1869 the capital, share and loan, amounted to £7,828,844, and the coals to 1,171,588 tons, which gives £6 13s. 8d. per ton, the highest amount of capital being £8 7s. 4d., and the lowest £4 10s. 6d., three of the 13 Companies being below the £5 standard.

This shows a very great and commendable improvement, and it shows, moreover, what may be done in the reduction of capital.

In 1877, another interval of eight years, we find only six Companies. The total capital amounted to £11,845,749, and the coals used to 1,614,246 tons, or £7 6s. 11d. per ton, the highest being £8 0s. 2d., and the lowest £4 15s. 8d., only one of the three Companies, with capitals below £5 per ton, being left, the other two having been amalgamated.

During this last interval, a great increase has taken place in the capital account of some of the Companies, while that of others has been very considerably reduced. The increase is accounted for by the gigantic works that have been erected, and has, therefore, to some extent, been unavoidable; but it ought to be reduced from year to year, as these works come more and more into use.

Notwithstanding all these variations in the capitals, the course of the Companies has been one of almost uniform prosperity, and the question naturally arises, How is it that these undertakings should be so prosperous? Either the principle laid down in this paper is altogether wrong, or there is something extraordinary in the circumstances under which Gas Companies exist.

Some will at once say that it is all owing to the absence of competition, which is, in a sense, correct; but if the inquiry is carried somewhat further, it will be found that the defective legislation, which has been brought to bear on the Companies from outside, by those who wished to exercise control over them, has the most to answer for.

The legislation controlling Gas Companies was framed in the days when competition was universal. I refer to the general Act of 1847, which was, for those circumstances, an exceedingly good and just Act, both for the public and the Companies; but when the circumstances had entirely changed, by the complete abolition of competition, this Act, in its relation to capital and dividend, became obsolete. This the Authorities did not see, and in the Metropolis Gas Act, 1860, they incorporated and reaffirmed, with some slight limitations as to back dividends, the 1847 Act. That it was a great mistake is, I consider, amply proved by the widespread and almost continual discontent which the public authorities have shown since 1860 towards the London Gas Companies, which dissatisfaction has been reflected in the provinces, resulting in endless inquiries in Parliament, which produced, after a three years contest, the Act of 1868, providing a power of revision. The notorious revision clauses utterly failed to give satisfaction; the discontent they produced leading to another protracted inquiry, which led, in 1875–6, to the adoption of the principle of the sliding scale, advocated by the writer before this Association in 1874. This was, at the time, vehemently opposed by the Companies, who allowed the right opportunity for its adoption to pass; but, after twelve months consideration, they effected a treaty of peace with the Authorities on that basis, and were compelled to accept the auction clauses, which I did not recommend, and, as a Gas Shareholder, do not like, but against which I cannot argue, for I consider them a just arrangement under the circumstances of non-competition in which Gas Companies are placed.

So far the sliding scale has worked satisfactorily; the public have not grumbled, but have rather commended the increased dividend that has, in one or two instances, been paid in London. I hope and believe that the Companies—who now express their satisfaction with the sliding scale—if bad times come, necessitating a reduction of dividend, will cheerfully acquiesce, for it is simple justice that producer and consumer should share in fair proportions the advantages of prosperity and losses of adversity.

The old legislation designed for competition, but continued after it was abolished, made it difficult to do right, and easy to do wrong in reference to capital; but now there is no excuse, thanks to the valuable tables compiled annually by Mr. Field, to legislation on sound principles, and to the light thrown on the question by the numerous public inquiries into the matter.

There is, however, ample justification for the excessive capitals of the Companies. *They* did not create the legislation, it was forced upon them by Parliament; *they* did not create a state of competition, it was forced upon them, in most, if not all cases, by the Consumers; therefore the Companies cannot be blamed for the natural result of Acts not their own, nor for reducing their capital by extending their works out of revenue.

Lest the advocates for competition should think that a return to it would be beneficial, let me say that it was the cause of a greater amount of waste and loss, both on capital and revenue account, than any other circumstance affecting Gas Companies—a waste and loss which ultimately fell upon the Consumer, and to this objection to competition must be added the immense public inconvenience that resulted from the multiplication of mains in the streets. Competition is utterly out of the question; it is a system most expensive to the Consumer, while it is ruinous to the Gas Company.

There is, however, one serious objection to a small capital. In these days, when scarcely a week passes without a report of a Gas Company having been purchased by the Local Authority, which fate stares all the rest in the face, it is but natural that the question of a reduction of capital should be looked at in reference to its effect on the probable terms of purchase. It is the fact that, with purchase in view, it is a positive and great disadvantage to a Company to reduce their capital. The rule is, not to take as the basis of purchase the intrinsic value of the concern, but only the amount of dividends paid. I will put a hypothetical case:

Company No. 1 sell 100 millions a year, and have for this purpose the moderate capital of, say, £50,000 (a trifle below the standard of £5 per ton); they divide amongst shareholders, at 10 per cent., £5000 a year, and the price they would receive from a purchasing authority would be, at 25 years purchase, £125,000.

Company No. 2 also sell 100 millions, but have the extravagant capital of £100,000, or nearly £10 per ton of coal; the dividend amounts to £10,000 a year at 10 per cent., for which they would receive £250,000, or double the amount of No. 1, or even if half the capital was at 7 per cent. they would then receive as dividend £8500, and as purchase-money £212,500, against £125,000 in the other case.

Where is the justice of this, and how can any Gas Company be expected to exercise such a high standard of exalted virtue as to reduce their capital when purchase on this system is in view? It may be thought that my illustration is much exaggerated, but such is not the case. A transfer has just been effected under the following circumstances:—The Company's able Manager has for years been working with the view to reduce the capital to a thoroughly sound basis, and has succeeded in bringing it well within the £5 limit, and in getting in addition a large excess of plant. The Counsel employed to conduct the case before the Arbitrators was unable ot secure more than the usual terms, although if the capital account had been run up to £7 or £8 per ton, the Shareholders would have received half as much again for the very same property.

What, then, is to be done? Parliament has, in a measure, caused, and has undoubtedly sanctioned, the past expenditure on capital. It may be wise to reduce this, and it is quite fair to effect the reduction out of revenue, but as to future expenditure on capital account there ought to be no doubt.

Capital may be lost by the construction of more expensive works than are necessary; and that there is a tendency in this direction there can be no doubt. Human nature likes grand things, and Committees of Town Councils, with the rates, as they say, behind them, as well as Boards of Directors, are not free from this infirmity. They are frequently carried away by an imposing appearance, when something much more simple and less expensive, while equally good, would answer the purpose. Contractors and Manufacturers naturally throw their influence into the scale in favour of expensive plant, and I can find no fault with them for doing so, except with those who find in it a larger margin for the exercise of the bribery to which some of them owe a large portion of their business, as one who signed himself a "Commission Abolitionist," in a letter he addressed to *The Times*, confessed that he had made his business, to a great extent, by this system, and then endeavoured anonymously to kick over the ladder by which he had mounted to prosperity, and at the same time to destroy the reputations of all connected with gas-works.

Engineers and Managers also have a laudable desire to make their works as substantial and good-looking as possible; but this often leads to loss of capital in needlessly expensive constructions. I do not by any means advocate anything paltry or shabby, but I believe that gas-works that are soundly, but not too substantially, constructed, well proportioned, and with an evident fitness for the purpose for which they are intended, without any direct attempt at ornamentation, and with economy apparent in every feature, will look when in use, and the dirt and smoke have had time to take effect, infinitely better than those highly ornate constructions that have such a fascination for some people. To my mind, this high art, as it may be styled, is out of place in gas-works, which, when placed in a suitable position, are scarcely ever seen, and, if seen, are not likely to be admired, except when quite new and clean.

Let it, then, be our object to produce the greatest effect with the smallest expenditure. A lavish expenditure may, in one sense, be a benefit to some, but economy and care on the part of each or any section of the community is the only way to create lasting prosperity.

A word as to revenue. In these times, when all traders are complaining, gas undertakings still find their revenue maintained. It is, however, their duty to make a right use of it; they are, in fact, bound, by the common bond of duty to the community, to exercise care and judgment in the appropriation of revenue; and to us, as Gas Managers, it is highly important that we should give our attention to this question as well as to that of capital.

Taking the gross revenue, which we will assume is carefully collected, and that the most has been made of all the sources from which it is derived, the first charge upon it is to pay for the materials and labour required in the ordinary working of the business; the second is the annual expenditure of so much of it as is sufficient to maintain the works and plant in thorough good order at the full capital value. Where portions of the plant have become obsolete or worn out, they should be renewed out of revenue, and in cases where apparatus of increased size is erected to replace that which is used up, only the cost of the additional gas-producing power should be charged to capital, the rest being borne by revenue. It seems almost waste of time to insist on such a self-evident principle, but it is necessary, because it is a very common practice to charge the whole cost of renewals to capital, and where new works are erected this is almost the universal rule. I suppose because the value or the original cost of the abandoned works is too great to be taken from revenue in any year; but where this is the case, a sinking-fund ought to be established, writing off from revenue a fixed sum yearly until the whole is liquidated in a reasonable time. It should be remembered that after the new works are erected, the charge for repairs for some years will be merely nominal; it would therefore be fair and right to charge against revenue the full normal amount for repair and maintenance, and thus reduce the capital by writing off something every year; or, if this cannot be done, by paying the cost of additional plant and extensions from revenue.

In the appropriation of revenue for the maintenance of works, there would be no difficulty if a fixed and certain sum each year were required; but it sometimes happens that a very large sum is required in a single year, as, for instance, when a gasholder has to be renewed, or a large gasholder must be erected in the place of a smaller one. The renewal is a charge that should be entirely borne by revenue, and, in the other case, out of the total cost of the gasholder, so much should be charged to

revenue as will represent the original value of the small holder. Supposing a small holder cost £3000, and in its place a larger one is erected, costing £10,000, of this sum £7000 is chargeable to capital, and £3000 to revenue.

Unfortunately, the various Acts of Parliament provide no depreciation-fund for meeting such cases; consequently, it very commonly happens that the whole £10,000 is charged to capital, thus making the accounts show £13,000 as the amount expended on this gasholder, while it is only worth £10,000. The creation of a suspense account, to liquidate the £3000, would, under these circumstances, be a proper thing to do. Anything, in fact, being better than to allow the £3000 to stand as part of the capital, with nothing to show for it; but suspense accounts should, if possible, be avoided.

The Gas-Works Clauses Acts provide that, after paying full dividends, and filling up the reserve-fund, all further profits shall go to the consumers, in the shape of a reduction in the price of gas, overlooking entirely the necessity for a depreciation-fund, or a maintenance-fund, which should be the first object of attention.

The only suggestion I am able to make is that, after filling up the reserve-fund, a moderate surplus should be gradually accumulated and carried forward from year to year as an undivided balance. I do not think any objection could be taken to this course, provided the balance did not assume unreasonable proportions. That an objection would be taken is most unlikely, seeing that any action by the Authorities, under the Act of 1847, is rarely, if ever, undertaken to compel a reduction of price. Such action against such a fund, accumulated honestly for the purpose herein indicated, would now be far less likely than before, seeing that recent legislation leaves the undivided balance perfectly free. I could give instances where the undivided balance has been of the greatest benefit to both Companies and Consumers, providing a fund for the former out of which to meet any extraordinary charge, which must otherwise have been met by an increase in the price of gas. I say, therefore, provide such a fund in advance, out of which to pay the charges for abnormal repairs.

The last charge upon revenue is the dividend. The expenditure on the ordinary working, together with that on repairs and on the sinking-fund, when necessary, having been deducted from the gross revenue, the balance only, whatever that may be, is available for dividend, any remainder going to form a reserve-fund. If the principles enunciated here are acted upon, there will be but little fear that, under any conceivable circumstances, the net revenue will be insufficient for this purpose, but I can conceive circumstances in which, if sound principles are neglected in prosperous times, the dividends may not only be seriously reduced, but destroyed. We have no right, because circumstances are in our favour, to neglect those principles on which alone a sound business can be founded; those principles must be maintained against mere expediency, and they will, in the end, be found to work the greatest good for the greatest number.

In conclusion, I must ask you to forgive any apparent dogmatism in this paper. I have no desire whatever to force my opinions upon you, although, when called upon, I am bound to express them. If they are unsound, I shall be glad if you will refute them; but if they are right, I hope they will be generally adopted, and that, in adopting them, increased prosperity may result to the Members of the British Association of Gas Managers.

Mr. Gore, as one who had suffered very considerably from what he believed was a misconception of the very important question now brought forward—namely, the relative proportion that capital ought to bear to works constructed for the manufacture of gas, wished to give a few words from his own experience and observation. For many years it was the custom to debit capital with all the expense connected with the promotion, construction, and completion of gas-works, and for many years it was considered that that capital was entitled to receive its maximum dividend. A clause in the Gas-Works Clauses Act of 1847 was looked upon as a clause which gave Shareholders an indubitable right to 10 per cent. on all the capital they had expended. The effect of reading the clause in that way, and the influence it had on gas property, was this, that there had been a disposition on the part of those who were connected with profitable gas-works to increase their investments in all directions, and no one could wonder that such was the case. It was the best investment in the country at the time, and gave the best guaranteed return on that capital; therefore, it was only natural that Shareholders should do their utmost to enlarge so profitable an investment. But what was the effect on Members of the Association—the men from whose brains must come that which enabled the capital to be made productive, and who were, therefore, deeply interested in seeing how the capital was expended? He need not ask the question, how much anxiety gentlemen had to pass through in order to meet that pressing demand for 10 per cent. on capital? If the capital had been reduced to such a point as would approximate to that which the works demanded, how much less anxiety would they have had in producing the return on that capital? Need he ask how many works there were whose working capital was not yet represented, to the extent of one-half, by the plant which was now in operation?—how much of it had been totally destroyed? He could refer to many works, and he almost thought he could point out one to which Mr. Livesey had alluded, where the original capital had been entirely destroyed, and new capital created; and yet the Manager was expected to pay a dividend on that double amount. Then there was another point of view of equal importance. Mr. Livesey had told them plainly that in this country they were accustomed to work with an unnecessarily large amount of capital. It had been his lot to visit a great number of works in various parts of the world, and he had been enabled to contrast the works constructed, not only in this country, but in many of the principal foreign cities, with those constructed essentially on what he might call British principles. He had seen works which fulfilled all necessary requirements, with all the retorts and plant economically in operation, at a reduction, in some instances, of 40, 50, or even 60 per cent. on the capital required for those constructed under the English *régime*. The facility with which capital was obtained in this country for the construction of works abroad had had this result, that Companies had burdened themselves with capital which, at the present time, did not show anything like the return it ought to do. He would take a case with which he was personally connected. They had the works constructed abroad, upon what he might call cheap principles, but which enabled them to supply the district economically and advantageously. The capital was, in round numbers, £40,000, and on that capital for eight years they had paid on an average 19¼ per cent. An English Company, established on English plans, with a plant only capable of making something like 10 million cubic feet a year more than their own, cost, as the balance-sheet showed, £118,000. Now, it was quite evident that, if the Manager of those works had been placed in competition with his, his 19¼ would appear a large return compared with about 6½ or 6¾ per cent. return from the other. He had in his mind's eye two or three concerns which he saw a few years ago in South America, where capital at least 40 or 50 per cent. more than it ought to have been had been expended in the works, and very naturally there was not a proportionate return. Gas Managers, therefore, had a great interest in keeping down capital. He believed the auction clauses objectionable, although they might appear to have a tendency in the right direction, provided they could inoculate Shareholders with common sense principles—namely, that if Managers and Engineers were to put their brains and intellect into their work, they should have the benefit. They had progressed within the last 50 years enormously. They carried on a business second, either in interest or domestic value, to no process carried on in the country.

Mr. H. P. Stephenson said he had no doubt the principle enunciated by Mr. Livesey, that all renewals, or partial renewals, should come out of revenue, was sound; but when a great amount of work fell in one year, it came hard upon a Company. The great difficulty he saw in meeting all the expenditure that might come in one year was that the profits might be depreciated in that half year. Mr. Livesey suggested a sinking-fund; but how did he propose that should be carried out? and was it possible, in the present state of legislation to have such a fund?

Mr. Mead (Sutton) thought they were much indebted to Mr. Livesey for his valuable paper. The figures he gave applied, as stated, more especially to large works than small works; and he must say that his experience had been limited to comparatively small works, with capitals from about £3000 to £300,000; and the difference between the capital necessarily expended in the establishment of those works was very great indeed. He put it, not as Mr. Livesey did, in tons of coal carbonized, for he did not think that was the most convenient form, but rather in thousands of feet of gas sold. In some works a much larger quantity of coal might be carbonized than elsewhere, although not so much gas was paid for; therefore, he based his calculations on the number of thousands of cubic feet of gas sold. He found that the capital averaged from about 16s. and upwards per 1000 cubic feet of gas sold. He was sorry to say he had lately joined a Board in which the capital expended was 34s. per 1000 feet sold. He did not mean to justify that at all, for there was evidently a large sum of money wasted. If the works were increased as the business extended, he agreed that all old plant disused should be compensated for out of revenue. He knew in former days, even at the works where the President was now Engineer, things had gone in a different direction. If he recollected rightly, when Mr. Livesey, sen., took the management of the South Metropolitan works, they were something like £80,000 to the bad. The Engineer was an extravagant man, and had spent, no doubt, too much, and, in order to pay good dividends, charged a great deal to capital that very properly belonged to revenue. It was a question what was fair to do. Supposing, for argument sake, that £1 per 1000 feet, or £1000 per 1,000,000 feet, would be a very fair sum for gas-works, there might be two Managers, one not quite so careful as the other; the one would buy a great number of things out of revenue, and so reduce the capital, until at last, as in the South Metropolitan Company, they would have a capital of something like 10s. 7d. per 1000 feet sold. In their case 1s. per 1000 feet would pay 10 per cent. on the capital all round; but with £1 of capital per 1000 feet it took 2s. to pay 10 per cent. How far, then, was it fair to now go on paying out of revenue certain sums which ought properly to come out of capital—he meant fair to other Companies, who had not the opportunity of doing so? The effect would be this—that one Company, in a very favourable situation, might earn full statutory dividends, and yet place a large sum out of revenue to capital account, by paying for things that ought properly to come out of capital. The result would be that one Company, say, at Plymouth, sold gas at 2s. 6d. per 1000, the other Company who had but acted fairly, not only to their Shareholders, but also to Consumers—for the Consumers for the time being had to make up this difference, whatever it was; and if a Company were spending out of revenue what they ought to spend out of capital, the Consumers for the time being had to find the money, though, ultimately, the succeeding Consumers had the benefit—could not afford to sell under 4s. The public said, "At Plymouth the gas is 2s. 6d.; why do you charge 4s.?" It had that damaging effect on other Companies. He thought the right principle was this—You ought to pay for all damage to your property, replacement of gasholders, and so on, out of revenue. If you turned out one holder, containing 100,000 feet, and put in one for 200,000, the one replaced ought to be charged to revenue. There should be a suspense account, and if too much was spent in renewal of property this year, more than could reasonably be paid for out of revenue by means of the suspense account, as much might be cleared off as could be afforded this year, and the balance next and the year after. But even this might be carried too far; and it was carried too far when the capital was reduced below what would be a fair sum for the construction of the works.

Mr. George E. Stevenson (Peterborough) said it appeared to him this question was one that required most careful consideration, and that it was one very difficult to decide upon. It was very difficult sometimes to ascertain the circumstances under which Gas Companies arose. It was somewhat easy to lay down a rule by which new gas-works should be constructed, but to say that the capital of any special Gas Company ought not to exceed so much, and that if it was more it was too high, was an arbitrary process which no one was justified in adopting, unless he thoroughly knew the circumstances under which the Company were constituted. For instance, his own Company was one which might easily be misinterpreted. It was a small Company, formed as late as 1863. Previously to that the gas-works were the property of a private individual, who managed his affairs on the most economical principle possible, for he never repaired anything. The consequence was the works fell into such a state of disrepair and incapacity that he was quite unable to supply gas, and unwilling to extend his supply. The consumers of the town of Peterborough, therefore, decided to go to Parliament to form a Company, which they did, and received powers to purchase the works of this private individual. They had to give for those small works, which produced, at that time, about 20 million feet a year, £30,000, and of that £30,000, not one shilling was represented at the present day in the Peterborough Gas-Works, because the whole of the apparatus was utterly useless, and had to be pulled down and new works constructed. That £30,000 saddled the small Gas Company at Peterborough with such a large amount of capital in proportion to the present make, that anybody seeing it at first would hold up his hands in astonishment. From the time the old works were purchased the most economical principles had been observed, and since that time a contingent-fund had been formed, and added to year by year, to which all unusual outlay, in the way of reinstatement, was charged. In most cases it was immensely difficult to attain to that point at which it could be said that capital was proportionate to the make of gas, and to charge a reasonable price, because the capital must necessarily bear its dividend, and Directors and Shareholders were not willing to lose their dividend for the sake of reducing the price. It appeared to him also that it was questionable whether it would be desirable, in such a case as that, or even one less remarkable, to deduct year by year a portion of the originally expended capital, with the object of finally erasing it from the books, because, to do that, it would be necessary to maintain the price of gas enormously. He was interested in the remarks of Mr. Gore with regard to English enterprise abroad, but from what he had seen on the Continent of Europe during three years experience, he found that Continental Companies were infinitely more lavish in their expenditure than any English. They not only spent money lavishly in works, but before the works were constructed, or anything was done in the floating of the Company, a large amount of capital was sunk and wasted. Certainly in Austria it was found that not

more than one-third of the capital was represented in actual works, the remainder finding its way into various people's pockets beforehand.

Mr. HUNTER (Salford) said that Mr. Livesey would perhaps inform them how a Company like his own could form a sinking-fund to meet extraordinary expenditure. In that respect probably Corporations might have an advantage over Companies. They might have more freedom in manipulation than a Company. In Salford they got over the difficulty by having two different funds—first a sinking-fund, which was applied to the reduction of the mortgage debt, a certain proportion of the receipts being set aside for that purpose, so that the entire debt would be paid off in about 50 years; then there was another fund for depreciation or replacement, to which they credited each year something like 2 or 3 per cent. Two or three years ago they were unable to put even 1 per cent. on one side, but during the past two or three years they had been enabled to make up for past deficiencies, and put as much as 3 per cent. to it. Last year they put £20,000 to that fund alone. This would soon swell up to a considerable amount, and out of it they could make all the renewals. Though this could be done in a Corporation, he did not know how far a limited Company could do it. The main object of the paper, however, was to show that the capital account should bear some relative proportion to the value of the plant, and the writer had given as a standard 11s. per 1000 feet. There was no question but that this could be done. They could keep their extensions within this margin, and it did seem almost impossible to account for the extraordinary discrepancies which were from time to time brought to light.

Mr. PENNY said he had noticed there was a mistiness in the description given by some gentlemen who had already spoken in reference to repairs and reinstatements, which ought to be cleared up. His experience in examining Companies accounts went to show that in many Companies if a new holder was erected, or new mains were laid down, they contented themselves with charging to revenue the cost of the new gasholder or new mains, and then debiting capital with the amount which the old gasholder or old mains produced. That was an explanation, to some extent, of the very large increase in many Companies capitals, and of the great disproportion between the capital of one Company and that of another, as shown by the sum per 1000 cubic feet which the capitals represented. Having regard to this great difference between the capitals of various Companies, he could not help thinking that this had something to do with it, though, no doubt, many practical men present could speak better on that point. As a matter of course, they knew that the old Companies, where they made works of small capacity, and where there had been a rapid growth—where they had to create and recreate—their capital would have a great tendency to swell up. It was a matter of little consequence what the capital was if there was a price for gas that would pay for it; but it was those Companies who had had constant contests, where the maximum price had been kept down, who had been driven to deal with their capitals in a way, perhaps, not the most proper. For when the Board had Shareholders to meet, and dividends to produce, there was a great temptation to deal with reinstatements in the way he had described. There was no doubt that if they had to begin gas-works now, knowing all they did know—taking a square piece of ground, putting down everything of the best form possible—they might make the capital account very small as compared with that of many old Companies. But they ought to have some feeling for those Companies who were born so early, and had had all the difficulties of early times to encounter. Those were the Companies who had been unable to create and maintain any reserve-fund. They were really objects of sympathy compared with those founded in later days, who had the benefit of all previous experience.

Mr. CARR (Halifax) wished to ask whether Mr. Livesey meant the standard which he laid down to refer to the capabilities of the works, or to the quantity of gas they sold. Some small works might be very favourably situated, and, up to a certain time, the capital might be small; but, if they were in a growing district, and had to extend, they might not consider it wise to incur expenditure, with a view to keep within that standard from year to year. They might have to make an addition, which would elevate the standard for the time being, until the demand again overtook the supply.

Mr. CHAPMAN (Harrow) said one important point was, whether the preliminary and parliamentary expenses ought to be charged to revenue. As a rule, those expenses were charged to capital. He thought Mr. Livesey's idea was a good one, and his (Mr. Chapman's) Directors had adopted that view. They had a very much larger capital per ton than Mr. Livesey spoke of, as they were a bought concern, like Mr. Stevenson's Company at Peterborough; but they had already written off £452 for preliminary and parliamentary expenses, which amounted to £2000, and intended to write them all off, although they had not yet paid a 10 per cent. dividend.

Mr. IRONS (Gosport) thought Mr. Livesey would add to the obligation he had conferred if he would tell those outside the Act of 1871 what reserve-fund they could form.

Mr. LIVESEY, in reply, said Mr. Carr had referred to Companies getting 10 per cent. That wanted a little correction in this direction. They did not get 10 per cent. after the passing of the Act of 1847 for a great many years—in fact, so long as competition lasted; but when that ceased, full dividends were in most cases secured. It was then the opportunity should have been taken to make those renewals. Mr. Stephenson spoke about the sinking-fund, but the reference to a sinking-fund was intended only to apply to cases, for instance, such as the Chartered Company in building Beckton. It was impossible for the Chartered Company to lay out many hundreds of thousands of pounds, part of which was in place of old works, amounting also to hundreds of thousands, and charge all of them to revenue; but he did think it would be advisable to form a fund which should in time redeem it. One of the London Companies had, by parliamentary sanction, a leasehold redemption-fund, and there might be seen in their accounts from year to year so much charged on the revenue account to that fund. Where it was a case such as the Chartered Company, they might have obtained a special authority from Parliament for a separate fund; but, in the case of small works, under the Acts of 1847 and 1871, he did not recommend going for an Act of Parliament for such a purpose. Still he thought the ingenuity of accountants might find out some means of meeting this without great difficulty. He did not profess to be a parliamentary lawyer, but he had found this out about Acts of Parliament, that in many particulars they were very imperfect indeed, and certainly not adapted to the circumstances to which it was supposed they were to apply. Therefore, in many cases he should say, if it is right to form such a fund, do it; and who was there to object? There were Companies under these old Acts who were carrying on business in such a way as this. He knew a Company who had hardly called up any capital at all for nine years, and yet that Company had in nine years renewed the works, and converted them from the most dilapidated, wretched state, into a thoroughly perfect condition, and beyond this they had also made great extensions out of revenue, thus reducing their capital, without any objection on the part of anybody. Certainly they had kept up the price of gas rather higher than was desirable, but now they were in a thoroughly sound position, and it would probably be reduced. The right way to deal with ordinary renewals was, that every year should bear its proper proportion. It required some little management to get into that system, but it was thoroughly possible to adopt such a system that the average cost of repairs should be about the same year by year. Again, it was possible to have an undivided balance to carry forward in prosperous years, and that was often done by Companies who might have something over and above the dividend, and possibly over and above the reserve-fund. He could name Companies who had reserve-funds, and then carried forward an undivided balance from year to year. The South Metropolitan, for instance, had their reserve-fund full, and another sum, almost equal, as an undivided balance, in 1872; but, as it happened, the coal famine came next year, and although they had reduced their price, the undivided balance tided them over the famine years very nicely. Where there were no Auditors to look after the accounts, he did not see much use in the Acts. As to Mr. Mead's remarks with regard to gas-works with capitals of from £3000 to £300,000, he had always regarded Mr. Mead as a man who did his work in a thoroughly good way, and on principles of the greatest economy; and, therefore, he thought he must be mistaken when he said that the amount was from 16s. per 1000 feet of gas sold for works from £3000 to £300,000. If Mr. Mead referred to works with a capital of only £3000, he was not going to dispute it, but for works with a capital of £300,000, he did dispute its necessity most emphatically. For works with a capital of £20,000 or less, 11s. per 1000 feet, or £5 per ton, was sufficient. Mr. Mead referred to one particular Company when he said the works exceeded in value the total amount of the capital, and he had already said they were not to be imitated. He thought they were just as far in error in one direction as the others were in the opposite. Those Companies who had reduced their capital below what it ought to be had inflicted a great injustice upon Shareholders and Consumers, and also on other gas people; in fact, they had done badly all round, for the Consumers had had to pay for the extensions which the Shareholders might have provided for out of capital. The Shareholders would have had increased dividend-paying investments, and the Consumers would have paid a fair price for their gas, and everything would have been right. With regard to Mr. Stevenson, he could quite sympathize with him, but as to paying £30,000 for that which was not worth anything, if any one chose to give a sum of money for that which was worthless, he must look upon that money as lost. It was only the exceptional circumstances in which Gas Companies were placed which enabled them to do such a thing. An ordinary trader could not give £30,000 for a mill which he had to pull down, and expect he was to get interest on that £30,000, as well as on the new building he erected. There might be special circumstances with which he was not acquainted, over which the Company had no control; but in that case he should say the safe and right course was to endeavour to reduce the capital as much as possible, and to make all extensions out of revenue, which could undoubtedly be done. With regard to the sinking-fund, for any legitimate purpose, such as the redemption of leasehold property, &c., he would consider a certain sum set aside annually for such a purpose as perfectly right, and that, whether provided for in the Act or not, it was not a matter to which objection could properly be taken. Mr. Penny had alluded to a certain mistiness on this question, and he was afraid that was the cause of a great deal of discrepancy in Gas Companies management. What they wanted to learn was the exact way of dividing capital and revenue, and there was a great deal of debateable ground between the two. To take an illustration from railways. One great railway enlarged its stations, and replaced iron rails by steel, and charged all the cost to revenue. Another one enlarged its stations, and replaced iron rails by steel, charging the difference in the value between the new station and the old, and the iron rails and the steel, to capital, though these things did not increase the earning power of the railway to any appreciable extent. He thought the course adopted by the first was the sound principle, whenever it could be done; though he would not say the other was wrong. In reply to Mr. Carr, he did not mean to say there ought to be an exactly defined certain sum for extensions every year, and that they ought not to exceed or go below that; but he maintained that, on the average of years, it ought not to exceed the sum he had stated. As to parliamentary and preliminary expenses, most Acts of Parliament said that expenses of that kind should be charged to capital; but that did not prevent them afterwards being written off. All they had to do was to endeavour to conduct their affairs on such sound principles as they would be compelled to do if it were an ordinary business, and then they would not be afraid either of Acts of Parliament, or Official Auditors, or any other Authorities. No doubt there was a good deal in the paper with which some gentlemen would not agree; but, if so, they were quite as free to hold their own opinion as he was. It was the result of his own experience, and must be taken only for what it was worth.

The PRESIDENT said whatever doubt might have been suggested to the Committee as to the propriety of introducing this paper, had been entirely set aside by the interesting discussion which had arisen. Mr. Livesey had referred to the widespread dissatisfaction which had existed since the Metropolis Gas Act of 1860, as showing that the manner in which Companies had conducted their business had not been satisfactory to Consumers and the Authorities; that the system was not satisfactory, or the results would have been better. He thought there was another way of regarding that question of dissatisfaction which had been expressed with regard to Gas Companies—namely, that since the passing of the Act of 1860, which consolidated and improved the value of the property so much, the London Companies had been paying very full dividends, and then, for the reasons which Mr. Penny had sketched out in his paper, they had been naturally objects of envy, hatred, and uncharitableness. As to the remarks that Mr. Carr had made on the influence of the Act, and the passing of the Act of 1847 having been to secure the payment of maximum dividends, he was glad Mr. Livesey had referred to it, because the influence of that Act was not by any means to secure maximum dividends, or to give anything like security to Companies that they should have maximum dividends. During the whole period between 1847 and 1860 he knew of no instance, and he believed there were very few cases of Companies paying full dividends. During all that time the competition which was thought so desirable to exist between people engaged in any business existed, and the result was high prices and small dividends. The "regulated monopoly" introduced partly by the Act of 1847, and confirmed by the Act of 1860, brought about that condition of things in which Gas Companies rejoiced at the present time. He would only say further that, while it was very desirable to watch the expenditure of capital, it was still more important to see to it that the works were always in full, efficient, and good condition, and money spent in that direction should not be looked at with too close an eye. So long as capital was well spent, it was well to spend it.

(To be continued.)

REDUCTIONS IN THE PRICE OF GAS.—The *Manchester Guardian* states that the Salford Gas Committee have decided to make a further reduction in the price of gas of 3d. per 1000 cubic feet to all consumers, commencing on the 1st inst. The rate within the borough has hitherto been 3s. 9d. per 1000 cubic feet. The Ilkeston Gas Company have just reduced their price to 4s. 2d. to small consumers, ranging downwards to 3s. 8d. to large ones, all subject to a discount of ½d. per 1s. for prompt payment.

ON THE ADVANTAGE OF REMOVING THE HYDRAULIC SEAL DURING THE DISTILLATION OF COAL.

By Mr. THEOBALD FORSTALL, New Orleans.

[A Paper read at the Meeting of the American Gaslight Association, at Cincinnati, Oct. 17, 1877.]

The advisability of relieving clay retorts from all pressure during the process of distillation, has been for years discussed by Gas Engineers on both sides of the Atlantic. The experiments of Grafton have been generally considered as proving conclusively that the deposition of carbon was due to pressure only; and numberless methods have been contrived and patented for the purpose of completing the efficacy of the exhauster, by removing the hydraulic seal entirely while the charges are working off.

Mr. M'Ilhenny, of Washington, was, I think, the first to adopt this system of distillation in the United States. His method of removing the seal was described by himself in a paper read in October, 1873, at the first Annual Meeting of this Association. His example was soon followed in many gas-works; but although several years have elapsed since the system was thus put into practical operation, I have seen no published records of the actual benefits derived from it, except such as were merely experimental, extending over a few days or weeks only. I propose, therefore, in this paper, to lay before you the results obtained by the exclusive use of unsealed dip-pipes, during three years continuously, in the New Orleans gas-works. Although I have no very startling statements to submit, I trust that the communication will be of interest, if only as an *accurate record of retort-house experience.*

The advantages which were expected to follow the removal of the hydraulic seal, stated in the order of their importance, were—

1. Increased production of gas per pound of coal.
2. Entire prevention of carbon deposits in the retorts.
3. Greater durability of the retorts.

We may determine from the facts stated below how far each of these advantages has been realized.

The system of carbonization in the New Orleans works has passed through three distinct phases since my first connection with the Company. During the first period ending in June, 1871, the retorts were worked at a low red heat, against a hydraulic seal of 4-inches. The exhauster was employed merely to overcome the resistance of the purifiers and gas-holders; the retorts being left under the full pressure of the hydraulic seal and of the scrubbers; and this pressure, from numerous observations with the gauge applied to the mouthpieces, was found to pulsate violently from a minimum of 4 to a maximum of 7 inches.

The second period extended from June, 1871, to May, 1873. The heats were raised to an orange colour; the hydraulic seal was lowered to 1·25 inches, and the exhauster regulated to maintain a vacuum of 1 inch in the main, so as nearly to counteract the seal. We had expected in this manner to relieve the retorts from all pressure, but the real effect was anything but this, and first opened my eyes to the mischievous action of the dip-seal. Repeated observations with the gauge* showed that with a perfectly steady vacuum of 1 inch in the hydraulic main, the actual pressure in the retorts was ever varying throughout the whole duration of a charge. The range at the beginning was often from a *vacuum* of 3·5 to a *pressure* of 3·5 inches; the oscillations being very rapid and violent, but gradually diminishing towards the end of the charge until the range was from 0·5 to 1·5-inch pressure. A table of one series of these observations is here inserted:—

Table of Pressures observed in Retorts under the Influence of the Hydraulic Seal.

Depth of seal 1·25 inches. Pressure in hydraulic main steady at —0·8† inch during all the observations.

—	Time after Retorts were Charged. Hrs. Min.	Range of Oscillations of Pressure in Inches.	Remarks.
Bed No. 17 . . .			
Retort No. 1 . . .	0 5	— 2·0 to 2·6	Oscillations of gauge very rapid and violent during all the trials.
" " . . .	1 30	— 1·0 to 1·4	
" " . . .	3 45	0·4 to 1·0	
" No. 2 . . .	0 5	— 2·4 to 3·6	
" " . . .	1 30	0·4 to 1·6	Stand-pipe partially obstructed.
" " . . .	3 45	0·6 to 1·6	Ditto ditto.
" No. 3 . . .	0 5	— 3·2 to 4·0	
" " . . .	1 30	— 1·8 to 1·8	
" " . . .	3 45	0·6 to 1·0	
" No. 4 . . .	0 5	— 3·4 to 3·4	
" " . . .	1 30	— 2·0 to 2·0	
" " . . .	3 45	0·6 to 1·4	Ditto ditto.
" No. 5 . . .	0 5	— 1·8 to 2·4	
" " . . .	1 30	— 2·2 to 2·2	
" " . . .	3 45	0·6 to 1·4	
Bed No. 18 . . .			
Retort No. 1 . . .	0 10	— 1·0 to 2·1	
" " . . .	1 00	— 1·0 to 2·1	
" " . . .	1 30	— 0·8 to 2·4	
" " . . .	2 00	— 0·8 to 2·4	
" " . . .	3 00	0·5 to 1·5	
" " . . .	3 30	0·5 to 1·5	
Bed No. 19 . . .			
Retort No. 2 . . .	0 10	— 1·2 to 2·4	
" " . . .	1 45	— 1·0 to 2·4	
" " . . .	3 00	— 0·6 to 2·4	
" " . . .	3 45	1·0 to 2·5	
" No. 4 . . .	0 10	— 2·0 to 3·2	
" " . . .	1 45	— 2·0 to 3·2	
" " . . .	3 00	— 1·2 to 2·4	
" " . . .	3 45	2·0 to 2·5	Ditto ditto.

The third period began May 17, 1873, ending in 1876, with the dismantling of the retort-house in which these operations were carried on, and the starting of new works. The heats were kept at a bright orange, but the weight of charges somewhat reduced. Every bed of retorts was provided with a pneumatic apparatus for removing the hydraulic seal, invented by H. H. Edgerton, Esq., of Fort Wayne, in which all the objections that I had found to exist in previous methods of accomplishing the same end were completely removed; and which I should like to describe and to praise here as it deserves, if it were not outside the object of my paper. The exhauster was now regulated to draw the gas from the retorts in a steady flow, keeping a constant pressure of 0·3 to 0·5 inch within these vessels.

During the whole of these periods the retorts used were of the same shape and dimensions (D form, 12 by 20 inches, and 9 feet long), most of them from the same makers, and of similar quality. They were set in beds of five, principally on Sabbaton's plan, and were fired and charged by the same stokers on the four-hour system. The coal used was Pittsburgh (or Youghiogheny) exclusively, without cannel or other enricher. Tables A, B, and C exhibit the results of each of the three periods under appropriate heads. The individual record of each bed is not given for the first period, except as regards the number of days under fire, because at that time the weight of coal daily carbonized by each setting was not separately registered; but the totals have been accurately established for this period, from the actual weights charged in the whole number of retorts included in the investigation, during their respective terms of action. For the two later periods, the exact weight of coal carbonized by each setting daily was recorded, and the totals given are the weights for each bed. In the recapitulation I have added a column of per centage of fuel used, in anticipation of possible questions on this point, although not bearing directly upon my subject.

Before calling your attention to the lesson conveyed by the tables, it may be well to formulate the governing principle underlying the different methods of working pursued during each succeeding period. This may be stated as follows:—

In the first period: To save the retorts from harm as much as possible, at the cost of diminished production of gas, under a vague idea that the gain on the one side would cover the loss on the other. The Manager in charge at that time was a practical gas-maker, not given to figures.

In the second period: To get all the gas out of the coal, leaving the retorts to the chances of a short but glorious existence.

In the third period: To keep up the yield of gas, improve its illuminating power, and save the retorts at the same time.

The tables (see next page) show the results to have been—

1. *As to Production per Pound of Coal.*

	Gas Made per Pound of Coal.	Charge of Coal per Retort in Four Hours.	Candle Ft., Referees Burner.
A. Low heats, with seal . . .	4·24	195·0	80·56
B. High heats, with seal . . .	4·95	194·6	69·30
C. High heats, without seal .	5·00	186·4	82·50

The marked increase in yield of gas from A to B was principally due to the higher heats, but also in part to an infiltration of furnace gases drawn into the retorts in the rapidly recurring intervals of vacuum, shown by the pressure tests during three-fourths of the time that the charges remained in the retorts. The low illuminating power of this period confirms this opinion in connection with the fact that in period C, when there was a constant steady pressure in the retorts, the candle power of the gas rose 20 per cent., with a larger yield per pound. From this cause, too, the increased production of gas in the third period, due to higher heats and lighter charges, is made to appear less than it really was. The removal of the seal, however, seems to have been followed by no increase in production of gas, not otherwise accounted for; and I think it may be safely asserted, therefore, that within the limits of pressure commonly found in retorts, no material increase of yield per pound will be obtained, with equal charges and equal heats, from the absence of the hydraulic seal; and, further, that if a vacuum be, even intermittently, maintained in the retorts, with or without the seal, an increase of volume will occur from infiltration, at the expense of the illuminating power.

2. *As to the Formation of Carbon.*

The actual quantity of carbon removed from the retorts was not weighed, but an accurate account was kept during the three periods of the loss of duty, in charges missed by each bed, whenever they remained idle for the purpose of scurfing or burning out the deposit. The measure of this loss affords a sufficiently fair index to the weight of carbon formed, for comparative purposes, as between periods A and C, but is not reliable for period B, for reasons to be given presently.

During the first period this loss of duty was 4·28 per cent. of the total weight of coal carbonized, while for the second and third periods it was, by a curious coincidence, exactly equivalent to 1·22 per cent. As the hydraulic seal was in active operation in the one case, and entirely absent in the other, it seems to be proved by this result that the removal of the seal simply does not prevent, or even lessen, the deposit of carbon with equal heats; but a further consideration of the question will change our interpretation of the figures, and show the important part really played by the seal in this matter. It is well known by every gas-maker that the deposit of carbon increases with increase of pressure; but it is not so well known, having until recently been merely suspected, that the greater and more violent pulsations transmitted by the seal to the gas in the retorts, under increasing pressure, are more potent by far in determining the excess of deposit than the mere pressure itself. This fact, which, as far as I can remember, was first stated *à priori* in a pamphlet issued several years ago by the Gibson Valve Company, has been quite lately proved by the experiments of Mr. Young, of Clippens, to whom we are indebted for several valuable contributions to the science of gas manufacture. His paper, "On the Causes Affecting the Quantity of Carbon Deposited in Retorts," read at the last meeting of the North British Gas Managers Association, I strongly recommend to the study of those of our members who may not yet have seen it. On this theory the per centage of carbon formed during our second period of high heats and violently oscillating pressure must have been even greater than it is shown to have been in the first period of low temperatures. What became of the excess above the 1·22 per cent. accounted for? My explanation is that it was consumed, as fast as deposited, by the oxygen drawn through the walls of the retorts during the vacuum intervals. I became convinced of this by the fact that the broken fragments of all the retorts in action at this period were white and clean on their fractured surfaces, without a trace of carbon in their pores, proving that there must have been a current of oxygen passing inwards sufficient at least to prevent the lodgment of carbon in the fire-clay, if not to consume the whole quantity deposited within the retort itself. If it be conceded, then, that the figures as to carbon in period B are misleading, and the comparison is made between the undisputed results in A and C, we find a clear diminution of 70 per cent. in the deposit obtained by the removal of the seal; the same result having only been reached under the action of the dips, in period B, by maintaining in the retorts an intermittent vacuum detrimental to the quality of the gas produced.

* These observations were begun at the suggestion of Mr. Edgerton, whose seal-removing apparatus was subsequently adopted.

† The minus sign (—) is used to express negative pressure or vacuum.

A.—First Period, 1868–1871.

Record of Performance of Twenty Beds, of One Hundred Retorts, 12 by 20 Inches.

These retorts were worked at low red heats, with hydraulic seal of four inches. Actual pressure in retorts, 4 to 7 inches.

No. of Bed	9	10	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Days under fire	393	596	928	619	762	647	687	892	842	821	731	732	587	622	670	671	687	701	693	769
No. of times cooled down	0	0	2	2	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1

Total days under fire	14,250	Average weight of coal carbonized per bed per day—pounds	5,852
Mean days under fire	712½	Average charge per retort every four hours—pounds	195
Total coal carbonized—pounds	83,332,000	Average production of gas per retort daily—cubic feet	4,960
Mean coal carbonized	4,166,600	Average yield per pound of coal—cubic feet	4·24
Total charges missed while clearing off carbon, in pounds of coal	3,566,600	Total production of gas—cubic feet	353,330,000
Mean charges missed while clearing off carbon, in pounds of coal = 4·28 per cent.	178,330	Mean production of gas—cubic feet	3,533,300

B.—Second Period, 1871–1873.

Record of Performance of Fifteen Beds, of Seventy-five Retorts, 12 by 20 Inches.

These retorts were worked at bright orange heat, with hydraulic seal of 1·25 inches. Actual Pressure in retorts ranging from —3·5 inches minimum to 3·5 inches maximum.

Number of Beds.	Days under Fire.	Number of Times Cooled Down.	Coal Carbonized.	Charges missed while Clearing off Carbon.	Average Weight of Coal Carbonized per Day.	Average Charge per Retort every Four Hours.	Average Daily Production of Gas per Retort.	Average Yield per lb. of Coal.	Total Production of Gas per Retort.
			lbs.	lbs.	lbs.	lbs.	Cubic Feet.	Cubic Feet.	Cubic Feet.
2	377	0	2,189,220	18,000	5,807	193·6	5,750	—	2,167,330
5	427	1	2,547,898	None.	5,967	198·9	5,908	—	2,522,420
11	408	1	2,414,387	31,000	5,918	197·2	5,859	—	2,390,240
12	374	1	2,274,395	13,000	6,081	202·7	6,020	—	2,251,650
18	412	0	2,375,492	34,400	5,766	192 2	5,709	—	2,351,730
19	371	2	2,114,930	40,000	5,700	190·0	5,643	—	2,093,780
20	342	1	1,983,392	18,000	5,800	193·3	5,742	—	1,964,560
21	285	1	1,709,914	10,000	6,000	200·0	5,940	—	1,692,815
22	446	1	2,671,475	30,600	6,000	200·0	5,940	—	2,644,760
23	452	1	2,617,297	51,200	5,790	193·0	5,732	—	2,591,125
24	455	1	2,635,910	39,000	5,793	193·1	5,735	—	2,609,550
25	546	1	3,131,587	59,700	5,735	191·2	5,678	—	3,100,270
26	520	1	3,125,675	74,600	6,011	200·4	5,951	—	3,094,420
31	495	1	2,765,393	12,000	5,586	186·2	5,530	—	2,737,740
34	315	1	1,805,741	13,000	5,732	191·1	5,675	—	1,787,685
	6225	—	36,362,706	444,500					
Mean	415	—	2,424,180	29,638 = 1·22 p. c.	5,841	194·7	28,913 = 5,783	4·95	2,399,940

C.—Third Period, 1873–1876.

Record of Performance of Nineteen Beds, of Ninety-five Retorts, 12 by 20 Inches.

These retorts were worked at very bright orange heat, without hydraulic seal, and the actual pressure in the retorts maintained at 0·3 inch.

Number of Beds.	Days under Fire.	Number of Times Cooled Down.	Coal Carbonized.	Charges missed while Clearing off Carbon.	Average Weight of Coal Carbonized per Day.	Average Charge per Retort every Four Hours.	Average Daily Production of Gas per Retort.	Average Yield per lb. of Coal.	Total Production of Gas per Retort.
			lbs.	lbs.	lbs.	lbs.	Cubic Feet.	Cubic Feet.	Cubic Feet.
2	585	5	3,146,300	26,300	5,378	179·3	5,378	—	3,146,300
3	705	0	4,208,740	81,000	5,970	190·0	5,970	—	4,208,740
4	717	0	4,198,485	51,000	5,855	195·2	5,855	—	4,198,485
6	751	0	4,315,350	64,800	5,746	191·5	5,746	—	4,315,350
7	753	0	4,291,055	58,000	5,700	190·0	5,700	—	4,291,055
8	797	0	4,528,225	53,500	5,681	189·4	5,681	—	4,528,225
9	811	0	4,502,385	53,900	5,551	185·0	5,551	—	4,502,385
11	521	2	2,865,860	35,500	5,501	183·3	5,501	—	2,865,860
13	672	1	3,596,130	30,800	5,351	178·4	5,351	—	3,596,130
13	797	1	4,453,905	82,200	5,588	186·3	5,588	—	4,453,905
14	835	2	4,516,570	34,000	5,409	180·3	5,409	—	4,516,570
18	921	0	5,238,330	56,100	5,687	189·6	5,687	—	5,238,330
19	842	1	4,784,810	57,400	5,682	189·4	5,682	—	4,784,810
23	927	0	5,280,790	58,000	5,696	189·9	5,696	—	5,280,790
24	928	0	5,231,115	63,500	5,637	187·9	5,637	—	5,231,115
30	537	2	2,900,470	73,000	5,401	180·0	5,401	—	2,900,470
34	1044	0	5,758,450	62,400	5,516	183·8	5,516	—	5,758,450
35	1024	0	5,636,070	46,500	5,504	183·4	5,504	—	5,636,070
36	926	0	4,956,100	41,000	5,352	178·4	5,352	—	4,956,100
	15093	—	84,409,140	1,028,900					
Mean	794	—	4,442,585	54,155 = 1·22 p. c.	5,595	186·5	5,595	5·00	4,442,585

Recapitulation.

—	—	Days under Fire.	Coal Carbonized.	Charges Missed on Account of Carbon.	Coal Carbonized Daily per Bed.	Charge per Retort every Four Hours.	Gas Made per Retort per Day.	Gas per Pound of Coal.	Per Cent. of Coke used for Fuel.	Total Gas Made per Retort.	Candle Power. Five Cubic Feet by Referees Burner.	Candle Feet per Pound of Coal.
			lbs.	Per Cent.	lbs.	lbs.	Cubic Feet.	Cubic Feet.		Cubic Feet.		
First Period	With dips	712½	4,166,600	4·28	5852	195·0	4960	4·24	46·0	3,533,300	19·0	80·56
Second Period	,,	415	2,424,180	1·22	5841	194·7	5783	4·95	43·0	2,399,940	14·0	69·30
Third Period	Without dips	794	4,442,585	1·22	5595	186·5	5595	5·00	36·6	4,442,585	16·5	82·50

3. *As to the Increased Durability of Retorts.*

Upon this point, the figures need no explanation, and are very instructive. During the first period of low heats, the average life under fire of each retort was 712½ days, producing daily 4960 feet of gas; a total duty of 3,533,000 feet. The higher heats of the second period raised the daily production to 5783 feet, but the intermittent vacuum shortened the average life to 415 days, and the total duty to 2,400,000 feet. I shall show presently the financial result of this change of base. Here, then, was a clean loss of more than 40 per cent. in the life of the retorts, and of 30 per cent. in their total efficiency (to say nothing of the loss in illuminating power), entirely due to the destructive effects of the combustion of carbon in their pores, produced by the attempt to counteract the pressure of the seal by the exhauster alone. When these retorts gave out, they were gone all over, breaking up into small fragments between which cohesion was utterly destroyed. Now note the change in the third period. Without the seal, with higher heats, but under a slight *steady* pressure, the average life was lengthened to 794 days, with a daily production of 5592 feet, and a total duty of 4,442,000 feet. The removal of the seal, and the substitution of a steady pressure, increased, therefore, the efficiency of the retorts 25·75 per cent. over that of the first period, and 85 per cent. over that of the second. Now would it alter the correctness of this view if it should be shown that a longer average life, and greater production of gas, had been obtained in other works from retorts of similar dimensions, without removing the seal; unless it were, at the same time, shown that a corresponding increase of efficiency had failed to follow its removal in the same works. For my object is not to present here a standard of efficiency, but merely comparative data which can only be opposed by corresponding terms. The shortest life of any bed in Table C was 521 days,

the longest 1044 feet. The injurious effect of cooling down a bed after it has been in operation, is indicated by the fact that the three shortest-lived beds in this table are those which had been cooled down more than once; whilst the highest duty was obtained from the beds kept constantly under fire. All these retorts, when broken up, were found to be thoroughly impregnated with carbon.

These technical results may now be supplemented by a statement of the actual pecuniary loss or gain incurred from each change in the method of working the retorts. Assimilating the prices paid during the three periods for coal, retorts, and stokers labour, to one common average for comparison, I find that the cost of retorts per 1000 cubic feet of gas produced was 2·83 cents in the first period, 4·17 in the second, and 2·25 in the third. The practical Manager saved his retorts to the extent of 1·34 cents per 1000 feet; but in accomplishing this fact he lost 9·06 cents in coal and 2·40 cents in wages, a net loss of 10·12 cents per 1000 feet, upon the annual production of 250 millions; a total of 25,300 dols. to the credit of the second period. In the third period the gain in coal due to extra yield was exactly balanced by increased cost of labour due to lighter charges; but the advantage of the dip removal is felt in the economy of the retorts; the gain being 1·02 cents per 1000 feet, or 4800 dols. per annum. The whole cost of fitting up 40 ovens of 200 retorts with Edgerton's apparatus was 1600 dols., which was thus entirely repaid from the benefit derived in the first four months after its application.

I have left out of account here all consideration of the money value of the changes in illuminating power in the three periods, because the quality of the gas having never been below the legal standard of 14 candles, the variations did not cause any loss or gain to the Company. Under higher statutory requirements, however, or when the use of inferior coals cannot be avoided, the removal of the seal would become of material pecuniary importance, in ensuring the full illuminating value of the gas produced.

I think that I have shown that the removal of the hydraulic seal is a real, substantial improvement in gas manufacture, effectually preventing the excessive deposit of carbon, improving the quality of the gas, and increasing the efficiency of the retorts. Like most other good things, however, it may be abused and turned to illegitimate uses. Some Gas Managers consider that all the carbon deposited in their retorts represents a *pro tanto* loss of gas, and consequently look upon its entire absence as a positive gain. By removing the seal and maintaining a vacuum in the retorts, they apparently prevent its formation; but, as a matter of fact, carbon is still deposited all the time. The real effect of this vacuum, as I have before pointed out, is to induce an inflow of oxygen, which consumes the carbon, destroys the retorts, and adds a certain per centage of carbonic oxide to the legitimate volume of coal gas. Used in this manner, the removal of the seal will be a delusion and a snare.

This heroic treatment of the carbon difficulty is based upon two errors—1. That it is an unmixed evil. 2. That it can profitably be entirely prevented.

1. It needs no argument to prove that a moderate deposit of carbon, far from being an evil, is of great positive benefit to clay retorts. By filling up the interstices of the loose granular material of which they are constructed, it cements the particles together, and, at the same time, bestows the quality of staunchness to the whole vessel, not otherwise possessed or obtainable by them. When weighed against these vital benefits, the loss of duty of 1·22 per cent. incurred to remove additional encroachment of the carbon is but a trifling inconvenience.

2. The formation of solid carbon in the retorts is a condition essential to the production of permanent gas from the distillation of coal as at present carried on. The quantity deposited may be increased or diminished by varying conditions; but so long as the heat in the retorts is sufficient to make gas at all, some carbon must be deposited. The oils and vapours, first given off from every portion of the charge of coal, must be further decomposed by greater heat; and their surplus of carbon, not included in the final combinations by which they are converted into permanent gas, must be deposited in the free state. The weight of carbon deposited, therefore, necessarily increases with the degree of heat to which the vapours are effectively subjected, and their, consequently, more complete decomposition and conversion into gas. It may then be said with truth up to a certain point—the more carbon in the retorts, the more gas in the holders; and, up to this point, the deposit does not detract from the illuminating power. But if the permanent gas thus formed be still further and unnecessarily decomposed, by prolonged and repeated contact with the heated walls of the retort, an additional increment of carbon will be deposited, which, in proportion to its weight, will impoverish the gas. Mr. Young thinks that when cannel or shales are used as gas producers, instead of caking coals, this prolonged exposure of the gas may, on the other hand, be beneficial. Now, the effect of the hydraulic seal is to produce just that violent pulsatory pressure of the gas which increases decomposition by multiplying frictional contacts of its molecules with the heated surfaces of the retort and of the incandescent coke. Hence the excessive deposit of carbon. Nothing less than the entire removal of the seal will remedy the evil, for it is not a question of absolute mean pressure, but of oscillations of pressure, which cannot be destroyed by any adjustment of the exhauster while the seal is preserved. Provided it be steady, the absolute pressure is not indeed of much consequence within ordinary limits, and, therefore, the advantages of removing the seal are as completely available to small works where no exhauster is used, as to the largest.

As a summary of the whole question, I shall now submit for discussion the following conclusions to which I have been led in the course of this investigation.

1. With equal heats, from equal weights of coal, little or no increase of gas is obtained by the removal of the hydraulic seal, unless a vacuum is maintained in the retorts; in which case the increase is not from the coal, but from the furnace; and the loss of illuminating power overbalances the gain in volume.

2. The removal of the seal prevents effectually the excessive deposition of carbon caused by over decomposition of the gas, and thus improves its illuminating power.

3. With an equal daily production of gas, the durability of clay retorts is nearly doubled by the removal of the seal, provided a slight pressure be steadily maintained within them during the process of distillation.

THE TRANSFER OF THE EXETER GAS-WORKS TO THE EXETER CORPORATION.

We have been favoured by Mr. Spice with a copy of the following heads of agreement, made the 25th of June, 1878, between the Corporation of Exeter and the Exeter Gas Company:—

The Company to have their Act, but to engage not to raise any money under it for one month from Royal Assent, and if within that period the Corporation give to the Company notice in writing of their intention to acquire the undertaking, the Company shall sell to the Corporation their undertaking as a going concern, on the following terms:—

1. The Corporation to guarantee maximum dividends under existing Act, by annuities payable half yearly, redeemable at option of Corporation at 25 years purchase.

2. Debentures, bonds, and other loans to be taken to by Corporation.

3. In addition to annuities or commutation thereof in paragraph 1, a sum of £7750 to be paid to the Company as representing authorized reserved fund. On payment of this sum the Corporation to be entitled, without further payment, to the site of the old gas-works agreed to be purchased by them from the Company.

4. The Corporation to pay all debts and liabilities incurred by or on behalf of the Company, and to take to and satisfy all contracts *bonâ fide* entered into up to the date of these presents on account of extension and enlargement of the works, mains, and services, or for the supply of materials used in the business of the Company, or for designs for such works.

5. The annuity of £250 per annum payable to Mr. Williams to be paid by Corporation.

6. The Corporation to be entitled to all book debts, stock, and other assets of the Company, as from 1st of July, 1878.

7. The Officers of the Company to be continued in their several capacities by Corporation, on the terms of their engagements with the Company.

8. The sum of £1500 to be paid to the Directors for their services in winding up the affairs of the Company, and carrying out this agreement.

9. The Corporation to pay all the costs of and incident to the obtaining of the Act.

10. A formal agreement to be prepared embodying these heads. If any difference arise, such agreement to be settled on behalf of both parties by B. B. H. Rodwell, Esq., Q.C., M.P.

11. If the Corporation give the notice hereinbefore referred to, this agreement to operate as from July 1, 1878, the Company carrying on the undertaking as Trustees for Corporation, until one month after date of notice, at which period Corporation shall be bound to take possession.

Signed on behalf of the Exeter Gaslight and Coke Company, June 25, 1878 . } R. P. Spice.

Signed on behalf of the Mayor and Corporation of Exeter, June 25, 1878. } F. J. Bramwell.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

The demand for all classes of round coal throughout this district continues extremely small, and what little business there is doing is generally of a very unremunerative character, so far as colliery proprietors are concerned. Very little best house coal is now being sold, the demand being chiefly for the inferior sorts suitable for kitchen purposes. Prices are without material change, best Wigan Arley at the pit mouth being still quoted at about 10s. per ton, common at from 7s. 6d. to 8s. 6d., Pemberton four-feet at 7s. to 7s. 6d., and common house coal at about 6s. to 6s. 6d. per ton. A few contracts continue to be placed in gas coal, but it is difficult to ascertain the prices that are being taken, beyond the fact that, in most cases, they are extremely low. The ordinary quoted prices are about 6s. 6d. to 7s. per ton for ordinary Wigan screened gas coal, and 8s. to 9s. for best Arley gas coal at the pit mouth, but these scarcely represent the figures at which the majority of the contracts have been taken. Common coal for steam and forge purposes is still very difficult to move, the demand both for home use and shipping being extremely small, and prices are very variable, according to the nature of the order; sales in bulk being pushed at extremely low figures. Prices at the pit mouth range from 5s. to 6s. per ton, according to quality. Engine classes of fuel have been moving off rather more freely, and prices are firmer, although no material advance has yet been made upon late rates, good burgy at the pit mouth being still offered at from 4s. 6d. to 5s., and good slack at about 3s. 6d. per ton.

Short time is still being worked at the collieries, the majority of the pits not now running more than about three or four days a week.

In the iron trade there has again been very little doing during the past week, but so far as local makes of pig iron are concerned, late rates are still maintained; No. 3 foundry delivered into the Manchester district being still quoted at 50s. to 50s. 6d., and No. 4 forge at 49s. to 49s. 6d. per ton. Finished iron is also without material change, Lancashire bars delivered into the Manchester district remaining at about £6 per ton.

The iron-works are very badly off for orders, and are but very irregularly employed.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The shipments of best gas coals from the Tyne Dock were fully an average last week. The best collieries are working full time, mostly in the fulfilment of contracts which run over the whole year. The principal part of the carrying is done by steamers, and loading turns are immediate. The second-class gas collieries are in no better position. The general local trade, however, continues to show symptoms of improvement. The markets for iron and chemicals are firmer and steadier, with a slight advance in prices. The demand from the Continent for both these articles is decidedly better. Second-class gas collieries go on from week to week pretty much in the same way they have done over a period of more than twelve months. They work short time, get poor prices, and are simply waiting for some improvement in the local trade. All are not doing that, however, as some collieries which were opened when coals were at an extravagant price, and could only pay when sold at these rates, have been stopped altogether. The better qualities of steam coals, like the better sorts of gas coals, keep a good position in the market. The leading pits have fair contracts on hand, and are able to get through a full fortnight's work. Second-class steam collieries in Northumberland show a little worse trade than otherwise. Prices are poor. Short time is wrought, and there is no demand for their coals. The household coal trade is doing an ordinary summer's business. Several more vessels loaded gas coals last week for the United States, as information was received in this country that the new Tariff Bill, which was brought into the House of Legislature at Washington, and which, if passed, would have abolished the duty of 3s. 6d. per ton charged by the American Government on British coals, has been shunted by the Protectionists for the year.

The freight markets on the Tyne and Wear were depressed last week. With the exception of freights to the Italian ports of the Mediterranean, which were a little higher on account of the bad home business. Scarcely anything was doing. Rates were lower to Cronstadt and the Baltic ports. A considerable number of small coasting and small Scandinavian sailing vessels have been in the Tyne more than a week, without being able to procure a charter which will pay. Steam rates to London were a little more last week than 4s. per ton; and freights for small sailing ships to load gas coals for the wharves below London Bridge were equally low—not more than 5s. 1½d. per ton.

The importation of timber has been fairly satisfactory within the past fortnight. Large vessels are arriving in the Tyne, laden with pitch pine from Florida, and vessels are bringing cargoes of ordinary building timber from North America. The timber trade is somewhat depressed. The building trade in the North has fallen away very much, and there is less demand for materials; and as iron is cheap, a good deal of it is used in building large structures, instead of timber.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

The thirty-third annual meeting of the Ayr Gas Company was held last Wednesday—Dr. Ronalds in the chair. A report was submitted, in the course of which it was recommended that the price of gas should be reduced to 5s. per 1000 feet, and that the usual dividend of 6 per cent., free of income-tax, should be declared. The report was approved of. Since the present Manager, Mr. James Robb, took charge of the works (a little over two years ago), the price has been reduced from 5s. 10d. per 1000 feet, much of the credit of which is certainly due to that gentleman.

At the last meeting of the Kilmarnock Town Council, held last Wednesday, the annual report of Mr. Dalziel, the Manager, on the corporation gas affairs, was under consideration. This showed a profit of £2014 19s. 5d. on the past year's transactions, and it was stated that the sale of gas was 39,019,850 feet last year, or an increase of 1,292,750 feet over the year ending June, 1877, while the sale had increased 39·5 per cent. since the works were taken over by the Town Council. A reduction in price from 5s. to 4s. 7d. net per 1000 feet was made, the discount to large consumers being discontinued. The business of the chemical works, for treating the residual products, is still a marked success.

The annual meeting of the Irvine Gas Company was held last week, on which occasion a dividend of 20s. per £10 share was authorized to be paid. The accounts showed that there was a balance of £1169 in bank, and the Directors were authorized, after payment of the dividend, to apply the balance for the new erections in connection with the works.

At the meeting of the Kilwinning Gas Company, held last Tuesday, a dividend of 8 per cent. was declared on the original £5 shares, and it was agreed to reduce the price of gas from 5s. 5d. to 4s. 7d. per 1000 feet. After considerable discussion, it was resolved to supply gas free of charge for lighting the public streets in the winter months, the lamps to be subject to the control of the Directors of the Company.

In the minutes submitted to the meeting of the Glasgow Town Council held last Thursday, it was stated that at a meeting of the Sub-Committee on Works it had been remitted to Mr. Foulis and Dr. Wallace to take off the burners and regulators of such number of the street-lamps as they might think proper, to test the same with the view of determining the quantity of gas now actually consumed by the various descriptions of burners in use. It was reported, on behalf of the Special Sub-Committee on Finance, appointed at last meeting, that they had met and conferred with the Special Sub-Committee of the Police Committee in reference to the price to be paid by the Police Authorities for the gas supplied to street and court lamps during the past year, but that the two Special Sub-Committees, after discussing the matter, could not come to any agreement in reference to the abatement claimed by the Police Authorities, on the ground that the burners did not deliver the quantity of gas charged for. In the course of the proceedings it was stated by the Lord Provost, that the contract prices for the higher qualities of coal for the ensuing year were considerably more favourable than those of last year, while as to the inferior qualities, the prices were not any higher than those paid for the same coals last year.

Dr. Wallace's report on the quality of the gas supplied in Glasgow during the week ending the 29th ult., shows that in no instance was the minimum illuminating power under 27·07 candles, the average ranging from 27·21 candles to 28·35 candles, and the maximum from 27·30 candles to 29·22 candles. The northern district showed the best results over the week.

On Monday, the 1st inst., an odd lot of Glasgow Corporation Gas 9 per cent. stock realized the firmer price of 215.

The annual meeting of the Bothwell and Uddingston Gas Company was held on the 1st inst.—Dr. Goff presiding. From the report, which was submitted and approved, it was shown that a very large increase in the consumption of gas had taken place during the past year, and that there was a proportionate increase in the income. The Chairman stated that extensive additions and improvements were now going on at the works, the cost of which would be about £2700, and the meeting unanimously resolved to authorize the Directors to issue 2000 new shares.

A large amount of business has been done in the Glasgow pig iron market at receding prices during the past week, the closing prices on Friday being 49s. 9d. cash, and 49s. 10d. one month, or 4½d. per ton under the previous week's closing quotations.

The Glasgow coal market is still in the same dull condition as has for some time been reported.

LAMBETH WATER-WORKS COMPANY.—At a meeting of the Proprietors of this Company, held at the offices, Brixton Hill, on Tuesday, the 2nd inst., Mr. Geo. Puckle, of Denmark Hill, one of the Directors of the Phœnix Gas Company, was elected to fill the vacant seat at the Board.

SUFFOCATION BY GAS.—According to the *Dublin Freeman*, a melancholy accident has just occurred at Belfast, by which two old ladies have lost their lives. Their name was Hamilton; they were sisters, and resided in the suburbs. They had workmen repairing their house, and some alteration was made in a gas-pipe in the drawing-room. Their bed-room was immediately above that apartment, and they retired to it on the night of Friday, the 28th ult. On the following morning, the servant found them both dead in bed, having been smothered by the gas. It would appear that the gas couplings below not being complete, the gas was flowing into their room during the night.

Register of New Patents.

857.—BARKER, E. D., Bedford Row, and HARRIS, A. G. R., Dorset Square, London, "*Improvements in ball-valves and other draw-off valves.*" Patent dated March 3, 1877.

For these purposes a peculiar india-rubber ring valve is used closing with the flow of the liquid against a seat of the same material and form. These parts are contained within a valve chamber in connection with the supply, and in the bottom of the chamber is an outlet aperture. Into the outlet aperture a cone is fitted, and when the cone is at or near its lowest position it closes the outlet aperture nearly water-tight, without the aid of the india-rubber valve and seating. The draw-off lever operates against the lower end or stem of the cone to raise it. The india-rubber seating surrounds the outlet aperture in which the cone works, and the india-rubber valve is fixed upon the upper end of the cone. Both valve and seating consist of stout india-rubber rings thinned off at their outer edges, which thus form somewhat flexible lips, and when the valve is closed down against the seat it is only these outer edges or lips which come into contact, and the two flexible parts having but a small area of contact form a perfectly fluid-tight joint.

922.—BROTHERS, W., Livesey Fire-Clay Works, near Blackburn, "*New or improved apparatus to be used in the manufacture of clay pipes, gas and other retorts, and other articles made of clay.*" Provisional protection only obtained. Dated March 7, 1877.

This invention consists of new or improved apparatus, to be used for cutting off the clay pipe, gas-retort, or other clay article from the vertical column or hollow cylinder of clay which has been forced upwards through the dies of the press, and also for supporting the cut-off pipe or article and so for lifting and transporting it to the drying shed, or elsewhere, as required.

959.—HARDISTY, G. E., Nottingham, "*Improvements in cocks and taps.*" Patent dated March 9, 1877.

In constructing a ball-cock according to this invention, the cock is formed in such manner that the outlet orifice at the end of the supply-pipe is closed by a ball pressed up to a ring of vulcanized india-rubber or other elastic material, which is contained in a recess around the outlet passage. To press the ball up to and against the elastic ring, a metal stem, moved endwise to and fro by the lever or arm which carries the float, is employed.

The shell is formed in two cylindrical parts, to screw together end to end. One part is formed to be soldered, or otherwise secured to the end of the supply-pipe, the other forms a cylindrical cap, which is screwed on to the end of the first part, and has an outlet spout or orifice passing from it; it also carries the pin, or axis of the float lever. At the end of the part which is secured to the supply-pipe is a recess, in which is a thick ring of vulcanized india-rubber. When the cap is screwed on, it compresses the ring and holds it in place. Fitted within the cylindrical cap is a ball of glass or other suitable material. The ball is pressed up to and against the elastic ring by a metal stem, which is also within the cap, and is moved endwise to and fro by the float lever as the float rises or falls. As the float rises and brings the lever towards a horizontal position, it forces the metal stem and the ball in front of it towards the elastic seat, and when the ball comes against the seat, the passage of water is effectually shut off.

965.—FOX, W. P., Sheffield, "*An improvement in spanners or wrenches.*" Patent dated March 10, 1877.

This invention relates to an improvement in spanners or wrenches, and consists in fitting a knuckle trigger or plate upon the upper part of the body of the spanner or wrench by means of a screw-pin, which is caused to take into a threaded hole to hold the plate in position. The stem of the screw-pin is encircled by a spring, which abuts at one end against a shoulder in the plate, and at the other against the head of the screw. The face of the plate is notched or formed with ratchet teeth to engage into corresponding teeth on the edge of a bar forming part of the moveable jaw, the teeth being so shaped that the loose jaw can be pushed in to fit the nut or head of the screw upon which the spanner has to operate by a sliding action, and be held in the required position by the engagement of the teeth. The plate has a knuckle at its under side to engage under a lip on the body, where they form a joint one to the other, and upon which the plate can be tilted when a tail piece is pressed upon to disengage the teeth; the tail piece projects slightly over the handle portion, and is curved to prevent it catching anything with which it may come into contact. The stem of the loose jaw is fitted in the body of the spanner to work up and down in it freely, so that when desired for the jaws to open, the loose jaw can drop by its own weight, on the teeth of the trigger plate being disengaged. The spring can be adjusted to suit the desired pressure by screwing in the screw-pin more or less.

APPLICATIONS FOR LETTERS PATENT.

2533.—SHEDLOCK, J. J., Notting Hill, London, "Improvements in the manufacture and purification of gas, and in apparatus connected therewith." June 25, 1878.

2538.—HART, J., SAMPSON, J. L., and COLEBROOK, C. T., London, "Improvements in the construction of pumping-engines." June 25, 1878.

2575.—PIEPER, C., Dresden, Saxony, "An improved water-meter." A communication. June 26, 1878.

2609.—BOULTON, M. P. W., Tew Park, Oxford, "Improvements in gas motor engines." June 29, 1878.

2639.—FIELDING, A., Old Jewry, London, "Improvements in gas-cooking stoves." July 2, 1878.

2643.—MELDRUM, R., Edinburgh, "Improvements in drawing-off liquids, and preventing the reflux of same, or of gases, through pipes, and in the construction of automatically-acting traps or valves, and fittings connected therewith." July 2, 1878.

2644.—ALSING, G. V., Bradford, Yorks, "Improvements in the treatment of sewage and other polluted waters and their deposits, and in apparatus employed therein." July 2, 1878.

2662.—KENYON, H., Warrington, Lancs, "Improvements in purifying gas, and in the manufacture of ammoniacal salts." July 3, 1878.

2680.—BALL, C. J., Brompton, London, "Improved apparatus for raising and pumping." July 4, 1878.

PATENTS WHICH HAVE BECOME VOID.

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £160 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

1565.—KENT, A., "Improvements in apparatus for charging and discharging gas-retorts, and for other similar purposes." June 13, 1871.

1622.—SOMZÉ, M. L., "Improvements in the construction of joints for water, gas, and other pipes." June 20, 1871.

TO GAS ENGINEERS.

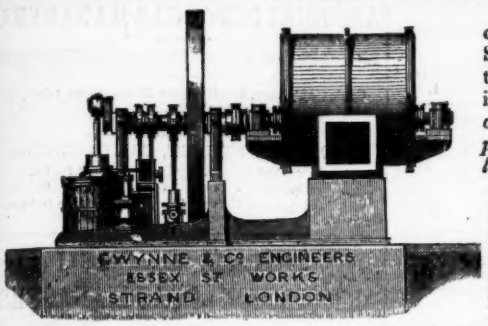
D. BRUCE PEEBLES & CO.

Beg to call the attention of Gas Engineers to the fact that the novel and original feature in connection with PEEBLES' SYSTEM OF CONTROLLING THE ACTION OF GAS GOVERNORS is the loading or acting on the Bell by Pneumatic Pressure instead of Weights.

TAY WORKS, BONNINGTON, EDINBURGH.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION, and TWO MEDALS at the PHILADELPHIA EXHIBITION, have been AWARDED to GWYNNE & CO. for GAS-EXHAUSTERS, ENGINES, and PUMPS;
Also 27 OTHER MEDALS AWARDED at all the GREAT INTERNATIONAL EXHIBITIONS.

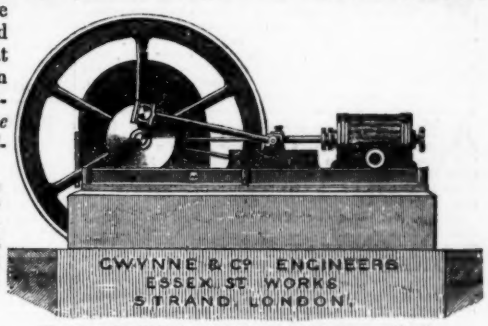
GWYNNE & BEALE'S PATENT GAS-EXHAUSTERS & ENGINES.



EXHAUSTER with Trunk Engine, capable of passing 210,000 cubic feet per hour.

The Judges report on the combined Exhauster and Steam-Engine exhibited at the Philadelphia Exhibition is—"*Reliable compact Machine, well adapted for the purpose intended, of excellent workmanship.*"

GWYNNE & CO. have made the largest and most perfect Gas-Exhausting Machinery in the world, and have completed Exhausters to the extent of 7,000,000 cubic feet passed per hour, of all sizes from 2000 to 210,000 cubic feet per hour.



52,500 EXHAUSTER, with Horizontal Engine combined.

GWYNNE & CO. do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, *but to produce machinery of the very highest quality, and most approved design and workmanship.* The result is that in every instance their work is giving the fullest satisfaction. Numerous testimonials and references can be given to Companies using their Machinery for years past.

Exhausters, with or without Engines combined, can be made to pass the gas without oscillation or variation in pressure Regulators, Bye-Passes, Stop-Valves, Gas-Valves, Station Governors, and Gas Machinery of all Sizes.

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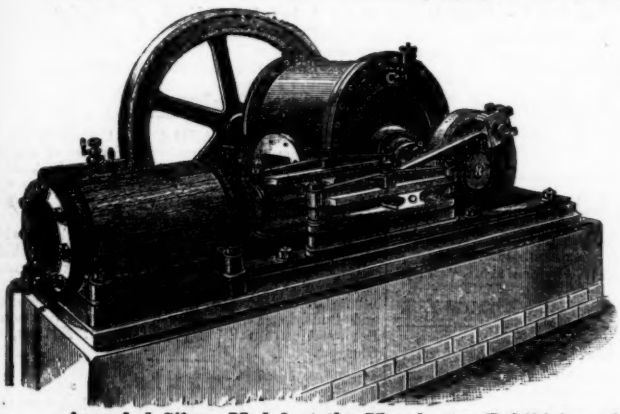
ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C., ENGLAND.
Gwynne & Co.'s New Catalogue on Gas-Exhausting and other Machinery may be obtained on application at the above Address.

BEALE'S IMPROVED PATENT GAS EXHAUSTERS



WITH

Wrought-Iron Spindles and

ENGINES COMBINED.

SOLE MAKERS,

GEORGE WALLER & CO.

MAKERS OF ENGINES, EXHAUSTERS,
INDEX AND DISC GAS-VALVES,
HYDRAULIC MAIN VALVES,
BYE-PASS VALVES,
TAR, LIQUOR, AND OTHER PUMPS,
SCRUBBERS AND PURIFIERS,
CONDENSERS, BOILERS, &c.

Awarded Silver Medal at the Manchester Exhibition of the Society for the Promotion of Scientific Industry.

Phœnix Engineering Works:
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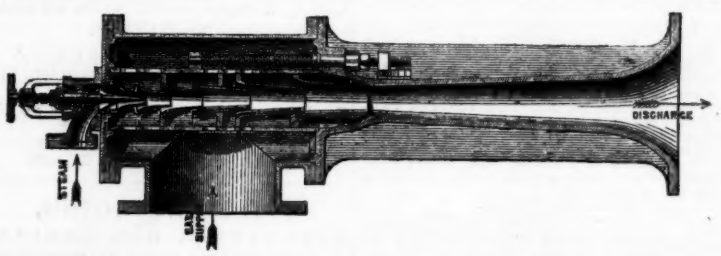

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IMPROVED CLELAND'S PATENT.

UPWARDS OF 250 IN USE.

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GERALD J. TUPP, 8, John Street, Adelphi, W.C.,
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SOLE AGENT FOR ENGLAND AND WALES.

WANTED, Readers of the Pamphlet, "Cooking and Heating by Gas;" on Burners, &c. Copies, by post, Threepence, direct from the Author, MAGNUS OHREN, Gas-Works, SYDENHAM, S.E.

WANTED—Condensers for a Works making 10 million per annum.
Price and particulars to be sent to W. MOODY, Manager, Gas-Works, Fareham, HANTS.

WANTED, by a Young Man, aged 22. who has had five years experience in a Provincial Works (make, 75 millions), a SITUATION in a Gas-Works. Can use Photometer, fair Draughtsman, good Writer, quick at figures, and thoroughly understands general routine.
Apply S. I. C. E., 54, Hardress Street, RAMSGATE.

WANTED, a competent Gas-fitter for Iron and Compo Tube. Constant employment. State age and experience. Certificates for honesty and sobriety required.
Apply, by letter only, to No. 473, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by the Sutton, Southcoates, and Drypool Gas Company, Hull, an experienced FITTER. He must be a good Main and Service Layer; able to undertake the Smith's work, and the ordinary repairs of the Works. None but a steady, industrious man need apply.
Application to be made by letter, with reference, stating wages, addressed to the MANAGER.

WANTED, by Samuel Thompson & Co., Colliery Office, Lancaster, APPLICATION for PRICES from Gas Managers who are prepared to receive Tenders for GAS COAL or CANNEL.
John Leigh, Esq., M.R.C.S., F.C.S., &c., &c., in his analytical report of S. T. & Co.'s Coal, says: "It is remarkable for its purity, I have scarcely ever examined a Coal containing so small a quantity of ash, and when Cannel of the best description is scarce, it may well replace this material."

WANTED, by a Young Man, a Situation in a Gas-Works. Capable of doing Smithing, Gas-fitting, or repairing Pumps, or take charge of Works during Manager's absence. Testimonials can be had.
Address No. 472, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Gas-Maker and a Stoker, Wages of Gas-maker 18s. per week in summer and £1 in winter, with cottage, coal, and vegetables. Stoker's wages 18s. per week, with extra time at 4d. per hour.
Letters of application, stating age, experience, and whether married or single, with testimonials or references as to character and ability, to be addressed to Dr. GILLAND, Berks County Asylum, Moulsford, WALLINGFORD.

A Young Man, aged 22, who has just finished a four years engagement with a provincial Gas Company is open to take a situation as Manager of small Gas-Works, or as Assistant to the Engineer of large Works. Can give first-class testimonials. Has no objection to go abroad.
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TWO Purifiers, 6 ft by 4 ft., 6-in. Valves and Connections, with Lifting Apparatus and Girders complete; also a Set of Twelve Pipe Condensers, all in working order, to be SOLD, a bargain.
Apply to Manager, Gas-Works, ENFIELD.

ON SALE—A Station-Meter (with new Drum), capable of passing 10,000 cubic feet per hour, with Hydraulic Valves, Bye-Pass, &c.; 10-in. Connections. Has been removed to make room for one of larger capacity.
For particulars and price, apply to GEORGE NEWTON, Gas-Meter Manufacturer, Union Street West, OLDHAM.

FOR SALE – One 50 ft. by 14 ft. Gas- HOLDER, nearly new, with Columns and Girders. Price £225, a bargain.
Also a STATION-METER, in good working order, to pass 15 000 feet per hour; and Four 10 ft. PURIFIERS with Hydraulic Centre-Valve.
Apply to J. S. REEVES, Manager, Gas-Works, BILSTON.

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THE Newest, Best, and Cheapest Plant for Making SULPHATE of AMMONIA. Plans may be obtained for the erection of this economical and efficient apparatus, or tracings of plans with specifications. Terms moderate.
Address JOHN G. HARVEY, Little Island, CORK.

TO TAR AND AMMONIA DISTILLERS.

THE Ilkeston Gas Company are desirous to receive TENDERS for their TAR and AMMONIACAL LIQUOR. The Contractor must undertake to forward proper railway tanks at all times during their contract, to keep down the Company's storeage cisterns.
Tenders to state price per Ton, and to be received at the Company's Office on or before Monday, July 15, 1878.
B. WILSON, Secretary.
Ilkeston Gas-Works, July 2, 1878.

TO TAR DISTILLERS.

THE Directors of the Dover Gas Com- pany are prepared to receive TENDERS for the Purchase of the Surplus TAR produced at the Gas-Works, Dover, for One year.
The Directors do not bind themselves to accept the lowest tender.
Tenders to be sent in on or before Friday, the 19th inst., marked "Tender for Tar," to G. Fielding, Secretary.
For information and terms, apply to the MANAGER, Gas Office, DOVER.
Dover, July 5, 1878.

WIDNES GAS-WORKS.

THE Gas Committee of the Widnes Local Board invite TENDERS for the REPLATING of a Single-Lift Gasholder, 50 ft. by 20 ft.
Specification and form of tender can be obtained from the undersigned.
Tenders, endorsed "Gasholder," and addressed to the Chairman of Gas and Water Committee, to be delivered at the Public Offices, Widnes, not later than the 1st of August next.
The Board do not bind themselves to accept the lowest or any tender.
HENRY ROBERTS.
Public Offices, Widnes, June 18, 1878.

MILLOM LOCAL BOARD.

THE Local Board invite Tenders for a Supply of about 500 Tons of good GAS COAL, well screened and free from pyrites, to be delivered at the Millom Station between the present time and the end of April, 1879, in such quantities and at such times as may be required.
Tenders to be sent to me not later than the 13th of July inst.
The Board do not bind themselves to accept the lowest or any tender.
JNO. POOLE, Clerk.
Millom, Carnforth, July 2, 1878.

NOTICE TO MANAGERS OF GAS COMPANIES.

THE LAW UNION FIRE AND LIFE INSURANCE COMPANY, of No. 126, Chancery Lane, London, grants Policies of Insurance on Gas-Works, and Buildings connected therewith, which cover risk of explosion and spontaneous ignition of Coal, on very advantageous terms. Full particulars will be sent post free on application to
FRANK M'GEDY, Secretary.
126, Chancery Lane, London.

COAL TAR.

THE Directors of the Canterbury Gas and Water Company invite TENDERS for the Purchase of their Surplus TAR (estimated at 50,000 Gallons), for One year ending July 1, 1879.
The Contractor must remove the Tar from the Works at his own expense, as required by the Manager, and pay for it monthly.
The Directors do not bind themselves to accept the highest tender.
Tenders to be delivered at the Company's Offices, on or before Thursday, the 18th day of July inst.
By order,
JAMES BURCH, Secretary.
Secretary's Office, Castle Street, Canterbury, July 1, 1878

MANCHESTER CORPORATION GAS-WORKS.

AMMONIACAL LIQUOR.

THE Gas Committee of the Corporation of Manchester are prepared to receive TENDERS for the Purchase of the AMMONIACAL LIQUOR to be produced at their Gaythorn and Rochdale Road Works during a period of One or more years, commencing from the 1st day of January, 1880.
In addition to tenders for the purchase of the Liquor in its crude state, the Committee will also be prepared to consider TENDERS for its DISPOSAL, either by manufacture into Sulphate of Ammonia at the above-mentioned Works on their behalf, or in any other manner.
The Committee reserve to themselves the option of accepting the offer, the terms of which they may deem most advantageous.
They do not bind themselves to accept the highest or any tender.
Sealed tenders, addressed to the Chairman of the Gas Committee, Town Hall, and endorsed "Tender for Ammoniacal Liquor," must be delivered at these Offices, on or before Tuesday, the 1st day of October next.
Forms of tender and further particulars can be obtained on application to Mr. George B. Jackson, at the Gas Offices. By order of the Gas Committee,
JOSEPH HERON, Town Clerk.
Town Hall, Manchester, May 31, 1878.

MANCHESTER CORPORATION GAS-WORKS.

AMMONIACAL LIQUOR.

THE Time for receiving Tenders has been EXTENDED from the 1st of August to the 1st of October next.
By order of the Gas Committee,
JOSEPH HERON, Town Clerk.
Town Hall, Manchester, July 5, 1878.

R. ANDREWS, Bricklayer and Retort Setter, 114, Elsley Road West, Shaftesbury Park Estate, LONDON, S.W. Estimates given for Building New Benches, Setting Retorts. References and terms on application.

MR. EDWARD SANDELL,
Associate of the Society of Accountants in England,
Publisher of the
"Gas Companies Expenditure Journal,"
Begs to announce his REMOVAL from Skinner's Place, Sise Lane, to
No. 2, GT. GEORGE STREET, WESTMINSTER.

Mr. ROBERT DEMPSTER, Sen.,
CONSULTING GAS ENGINEER,
Of Messrs. Robert Dempster and Sons, Rose Mount Gas Engineering Works,
ELLAND, near HALIFAX,
May be consulted on all matters connected with Valuations, Arbitrations, and Parliamentary Applications connected with Gas-Works. Our R. D., Sen., having been engaged on extensive Arbitration Cases, which, combined with his experience in Construction and Contracting, his knowledge of Engineering and Valuations, is both extensive and reliable.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.
Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.
Patents procured for Foreign Countries.
Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street, WESTMINSTER.

JOHN ROMANS, C.E., F.G.S.E.,
CONSULTING GAS ENGINEER
AND
CANNEL COAL FACTOR,
30, St. Andrew Square, EDINBURGH.

Plans and Estimates furnished; Gas-Works, Apparatus, Pipes, Machinery, Fire Goods, &c., supplied, or Attested and Shipped for Exportation.
GAS-WORKS TAKEN ON LEASE.
Mr. ROMANS has for upwards of 30 years been practically engaged in the Manufacture of Gas, and has, by extensive experiments, ascertained that by JUDICIOUS INTERMIXTURE of the lighter with the heavier gases, much of the rich Hydrocarbons CAN BE SAVED, which otherwise ARE LOST, during the process of manufacture. He is therefore enabled to give advice to those who favour him with their orders for Cannel, as to the class which will secure for their standard of illuminating power the HIGHEST ADVANTAGEOUS RESULTS.
ANALYSIS AND PRICES FORWARDED ON APPLICATION.

A PAMPHLET ON DIP-PIPES, &c., post free 6½d., on application to W. WHITE, Gas-Works, Aberaychan, MON. See Reviews in the *Gas Trade Circular and Review*, March 29, 1878, and *Design and Work*, March 30, 1878.

BRITISH ASSOCIATION OF GAS MANAGERS.

PHOTOGRAPH of MEMBERS at KENNINGTON.

Copies of either, or all Three Photographs taken, may be had on application to the Artist,
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DENMARK STREET, CAMBERWELL.
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Packed ready for delivery. They are too large to be sent by post.

NORTH BRITISH ASSOCIATION of GAS MANAGERS.

THE
SEVENTEENTH ANNUAL GENERAL MEETING
of the Members of this Association will be held in the
UNITED COLLEGE BUILDINGS,
ST. ANDREW'S,
On THURSDAY & FRIDAY, July 11 *&* 12, 1878.
J. HALL, Esq., PRESIDENT,
Will occupy the Chair.

PROCEEDINGS.
THURSDAY, JULY 11.
BUSINESS MEETING.
Chair to be taken at Half-past Ten o'clock A.M.
Reading of Minutes.
Admission of New Members, &c.
PRESIDENT'S INAUGURAL ADDRESS.
Auditor's Report.
Election of Office-Bearers.

LIST OF PAPERS AND COMMUNICATIONS.
"How should the Illuminating Value of Gas be Determined?" By Mr. A. MACPHERSON, of Kirkcaldy.
"The Necessity for a Proper Control over the Pressure of Gas for Illuminating Purposes." By Mr. ALEXANDER MITCHELL, of Dundee.
"Governors for Lamps and Stair Lights," with Description of an Improved Metallic Governor, which will be shown in action. By Mr. D. BRUCE PEEBLES, of Edinburgh.
"A Graduatory Method of Condensing, Washing, and Purifying Coal Gas by a Combined System of Rotary Apparatus." By Mr. D. M. NELSON, of Glasgow.

DINNER.
At Half-past Four o'clock, the Members and Friends will Dine together in the "Royal" Hotel, St. Andrew's. Tickets for the Dinner, 5s. each, may be had from the Secretary; early application for which is specially requested.

FRIDAY, JULY 12.
Chair to be taken at Ten o'clock.
Reading of Papers, and Discussion not completed, will be resumed.

PRIZE PAPERS.
COMMITTEE'S REPORT THEREON.

Gas Apparatus of various kinds will be exhibited in operation, and described.
WM. MACKENZIE, Secretary.
Gas-Works, Dunfermline, June 28, 1878.

T. NEWBIGGING,
CONSULTING GAS ENGINEER.
5, NORFOLK STREET, MANCHESTER.

W. LIDDALL,
Public Accountant,
15, UNION COURT,
OLD BROAD STREET, E.C.

ALFRED LASS,
SPECIAL ACCOUNTANT FOR GAS COMPANIES,
30, GRACECHURCH STREET, LONDON.
Accounts analyzed and Statistics Prepared for Parliamentary Proceedings, Arbitrations, &c.
The Forms of Account, which have been specially designed by A. L. to meet the requirements of the Gas-Works Clauses Amendment Act, 1871, are now in use by many Gas Companies, and have been universally approved.
The above forms are registered.
Water Companies Accounts also prepared and adjusted.
CONSULTATIONS.

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OF

KING'S TREATISE

ON THE

SCIENCE AND PRACTICE OF THE MANUFACTURE & DISTRIBUTION

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EDITED BY THOS. NEWBIGGING, C.E., M.Inst.C.E., AND W. T. FEWTRELL, F.C.S.

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J. BEALE'S NEW PATENT GAS EXHAUSTERS

MANUFACTURED SOLELY BY

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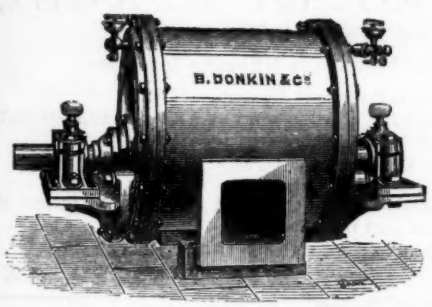

These Exhausters have but one solid slide, which ensures less wear and friction, and thus fewer repairs are necessary. They are made with two outside bearings and with all latest improvements.

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STEAM-ENGINES FOR DRIVING GAS EXHAUSTERS.
IMPROVED GAS-VALVES.
VALVES FOR AMMONIACAL LIQUOR, TAR, and HYDRAULIC MAINS,
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SCALES, AND GAUGES.
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LISTS, PRICES, AND INFORMATION ON APPLICATION.

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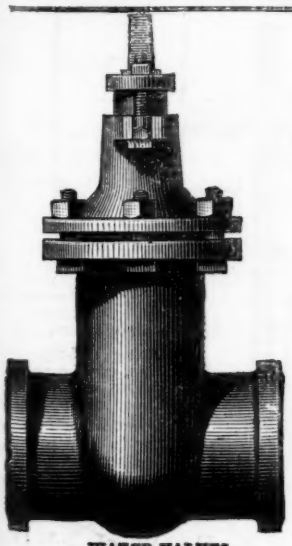

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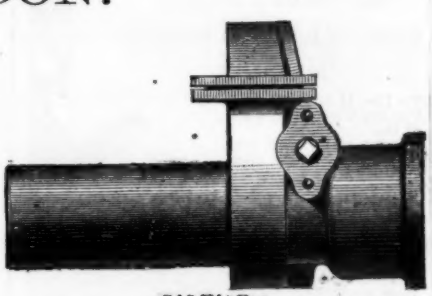

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Are prepared to Supply their excellent GAS COAL on very favourable terms.

This Coal yields more than 10,000 cubic feet per Ton of gas of good quality, *in practical working on the large scale.*

A large purchaser reports the coke to be clear, of a quality rarely equalled in the retort-furnace, and much liked by the stokers.

CATHELS'S Patent Gas-Washer is an

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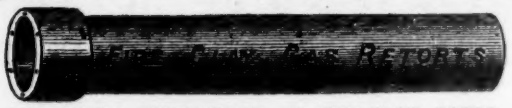

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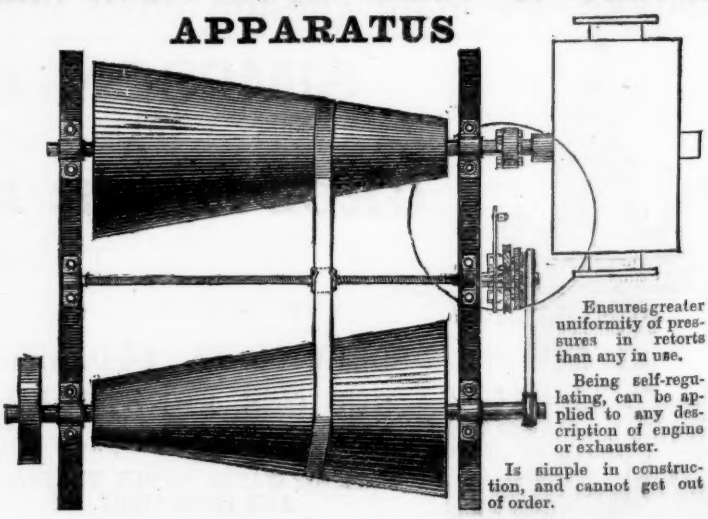

Ensures greater uniformity of pressures in retorts than any in use.

Being self-regulating, can be applied to any description of engine or exhauster.

Is simple in construction, and cannot get out of order.

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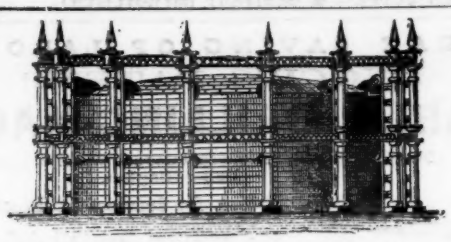

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GAS AND WATER WORKS.

THE AMERICAN GAS-LIGHT JOURNAL.

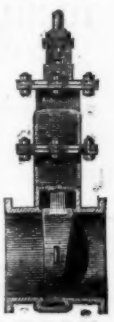
A. M. CALLENDER & CO., Proprietors. G. WARREN DRESSER, Editor.

Issued Semi-Monthly at No. 42 Pine Street, New York City.

This Journal is especially devoted to Gas Engineering and Manufacture, and is the official organ of the AMERICAN GAS-LIGHT ASSOCIATION, and the NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Subscriptions at $3.50 per annum, post paid, to Great Britain, may be made direct by forwarding Post Office Money Order or Draft to the above address. Rates of advertisement, $2.00 an inch. Special rates for larger spaces

C. & W. WALKERS' DOUBLE-FACED GAS-VALVES.



These solidly constructed double-faced Gas-Valves have taken the place of the old system of the light, single-faced disc, which is too uncertain and unreliable in large bores.

They are guaranteed absolutely gas-tight. They are very massive and rigid, and by improved modes of manufacture they are produced at very little excess in cost over the old light, weak system, which is liable to spring and bend, and become leaky.

The Valve is a rigid wedge of solid cast iron, having two perfectly scraped surfaced facings fitting between the two on the body, which are also surfaced.

A spring in two short halves, and, therefore, not liable to break, is used only for scraping the front facing clean.

The front facing is vertical; the back facing forms the wedge.

At a slight additional expense both flanges are faced to bolt to main-pipes.

MIDLAND IRON-WORKS,

DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

IMPROVED COMPENSATING GAS-METER.

HUNT'S PATENT.

This Meter supplies a want long felt, by putting an end to the loss sustained by Gas Companies through the overworking of their Meters.

These Meters can now be supplied in either TIN-PLATE or CAST-IRON CASES, and OLD METERS converted to this plan. GAS COMPANIES and CORPORATIONS will find it to THEIR ADVANTAGE to adopt these Meters.

EXTRACTS FROM REPORTS.

"I am able to report that the Meters have given in each test most satisfactory results."—*Mr. H. Sporne, City of London Meter Inspector.*

"I consider the arrangement is a great improvement upon the Meters in present general use."—*Mr. T. Jackson, Meter Inspector, Birmingham.*

"I would observe from the results of my testings that the Meters are a great improvement on the ordinary Wet Meters in general use."—*Mr. H. Airey, Meter Inspector to the Metropolitan Board of Works.*

COPIES OF REPORTS SENT ON APPLICATION.

MANUFACTURED BY

JOHN BENT & SON,

WET AND DRY GAS-METER AND GAS APPARATUS MANUFACTURERS,

BELL BARN ROAD, BIRMINGHAM.

Established 1830.

CADZOW COAL COMPANY,

LIMITED.

Cadzow Collieries, Hamilton (Lanarkshire).
Office: 161, Hope Street, Glasgow.

Report on the Cadzow Ell Coal.

By Dr. W. WALLACE, F.R.S.E., F.C.S., Gas Examiner for the City of Glasgow.

I have made a careful chemical analysis and practical assay of an average sample of the Ell Coal from Cadzow Colliery, received on the 5th inst., from Messrs. The Cadzow Coal Company, Hamilton, and have obtained the following results:—

Analysis.

Volatile matters	Gas, tar, &c.	34·03	46·12
	Sulphur	·04	
	Water, at 212° Fahr.	12·05	
Coke	Fixed carbon	52·90	53·88
	Sulphur	·03	
	Ash	·95	
			100·00

Coke (dry) per ton of Coal, 1205 lbs., or 10 cwts. 3 qrs. 1 lb

Analysis of the Coke (Dry).

Carbonaceous or combustible matter	98·18
Sulphur	·06
Ash	1·76
	100·00
Specific gravity of the coal	1·250
Weight of a cubic foot in pounds	77¾

Practical Results.

Gas per ton of coal at 60° F. and 30 in. bar.	10,122 cub. ft.
Illuminating power in standard sperm candles by Argand jet, consuming 5 cubic feet per hour	16·76 candles.
Value of one cubic foot of gas in grains of sperm	402
Equivalent of a ton of coal in pounds of sperm candles	581
Durability of one cubic foot of gas by 5-inch flame	42 min. 45 sec.
Gravity of the gas, air = 1000	448

Remarks.

The sample tested consisted of a complete section of the seam, 5 ft. 6 in. in thickness. The results show that this Coal is well adapted for the manufacture of gas and coke, both being for soft coal of very fine quality. Of the many hundreds of coal samples I have tested, I have not hitherto had one with so small a proportion of ash as the Cadzow Coal. WILLIAM WALLACE.

Chemical and Gas Laboratory,
138, Bath Street, Glasgow, March 15, 1878.

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WORKS:
DARTMOUTH & BRIXHAM (TORBAY) DEVON.
OFFICES:
3, GREAT GEORGE STREET, WESTMINSTER, LONDON, S.W.

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WOLSTON'S CELEBRATED
TORBAY IRON PAINTS.

TRADE MARK

These Paints have been for many years extensively used in Her Majesty's Royal Dockyards, Woolwich Arsenal, the Shorncliffe and Curragh Camps, War Departments, and Colonies, and are largely supplied to Railway, Harbour, and GAS COMPANIES, Shipowners, Engineering Establishments, Railway Carriage and Wagon Works, and the Paint Trade generally. They are the BEST PROTECTORS of WOOD, CEMENT, and IRONWORK, even arresting corrosion after it has set in; and their base being oxide of iron, they are free from those properties which make lead paints so destructive to iron. They do not scale or blister, are not affected by great heat, and are the only Paints which will resist the effects of sulphuretted hydrogen. Their DURABILITY and covering properties have borne the test of A QUARTER OF A CENTURY'S PRACTICAL TRIAL.

The undermentioned colours—ground in best linseed oil, and requiring only to be thinned down for use in the ordinary way—are kept in stock:—

Torbay Brown.	Torbay Red.
Dart Green.	Slate.
Dart Yellow.	Buff.
Brixham Black.	Torbay Chocolate.
Light Blue.	Cream Colour.
Dart Brown.	Dart Umber.
Imperial Stone.	Light Stone.
Bronze Green.	Salmon Colour.
Navy Green.	Lead Colour.
Carriage Red.	Dark Stone.
Light Lead.	Crystal Palace Blue.
Light Green.	Iron Grey.

All other Colours made to order.

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A great variety of Colours ready mixed for the brush are also always kept in Stock, in 3 lb., 7 lb., 14 lb., and 28 lb. cans.

Prices and Testimonials on application.

GREAT SAVING OF LABOUR.
ENOCH'S PATENT
PORTABLE DRILLING-MACHINE,

Now in use by all the Principal Gas and Water Companies in the United Kingdom.

E Size, for Services in Pipes, 2 to 3 in. bore	£3 10 0
F Size, for Services in Pipes, 2 to 4 in. bore	4 0 0
G Size, for Services in Pipes, 2 to 6 in. bore, with Telescope Cramp.	4 10 0

Drills, 1s. 6d. each.

Machines sent on approval, if desired.

Prices for other Sizes and Modifications, with full Particulars and Testimonials, on application to

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Office: 9, London Street, E.C. Warehouse: Vine Street, Minories, London, E.

GAS PURIFICATION.

BAILES & HALLSWORTH,

CONTRACTORS FOR THE

PURIFICATION OF COAL GAS

BY THEIR

PATENT HYDRATED PEROXIDE OF IRON MATERIAL.

The Material is adapted specially for taking up sulphuretted hydrogen, and will simultaneously absorb any ammonia that may pass the scrubbers.

The spent oxide resulting from our Material is more valuable than that from natural oxide of iron, and manufacturing chemists buy it in preference.

The Material has now been in use during the past three years in most of the principal Gas-Works in Yorkshire and elsewhere.

It contains considerably less moisture than natural oxide of iron, and is much cheaper and more efficient as a purifying agent.

B. & H. are purchasers of Spent Oxide, or will take Spent in exchange for New Material.

FOR SAMPLES AND TERMS, ADDRESS—

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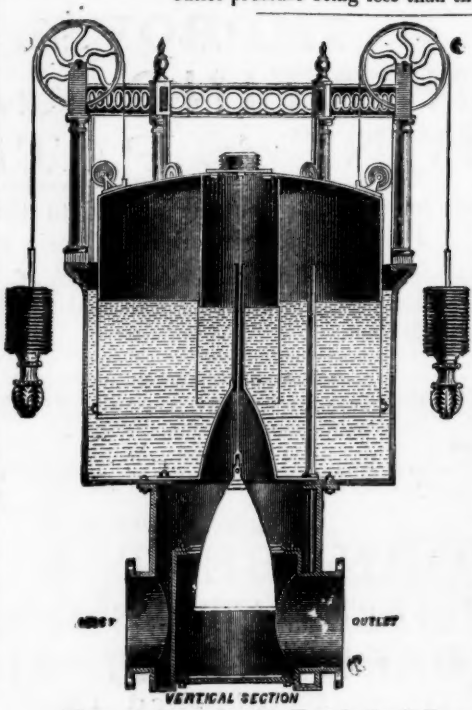
J. & J. BRADDOCK,
GLOBE METER-WORKS,
OLDHAM,

Beg to submit to Gas Engineers their

PATENT COMPENSATING GAS GOVERNOR,

Which is designed to give an uniform pressure at the Outlet to the Main at all draughts up to the full quantities which the Governors are made to control, such outlet pressure being less than the initial pressure.



VERTICAL SECTION

The uniformity of pressure is obtained by introducing a compensating chamber into the Bell or Holder of the Governor, which compensator is of the same area as the valve, both of which are operated on by the initial pressure, thereby placing the valve in equilibrium, no matter what the initial pressure may be. The action on the Bell is by the Gas passing along a pipe from the outlet, and the pressure is regulated by weights in connexion with the Bell as required.

From the sectional elevation attached hereto, it will be seen that only the Gas required to operate the Bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. That in case of accident to the Bell, no more Gas can escape than would pass up the pipe covering the valve-rod and Bell supply-pipe.

These Governors have been made and sent out of various sizes for from 2 to 24-inch Mains, and give most satisfactory results.

They can be made with Float in the Bell, or counterpoise as per section.

F. & C. OSLER,

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BROAD STREET, BIRMINGHAM.

ESTABLISHED 1807.

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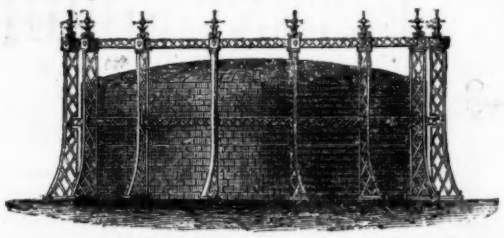
WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.

TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.



THE HORSELEY COMPANY,

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GAS OR WATER WORKS;

ALSO

MAKERS OF ROOFS, BRIDGES, &c.

MANN & OWENS' PATENT GAS-VALVE.

VALVE, with Indicator or Above Ground.

EVERY VALVE WARRANTED TO BE PERFECTLY SOUND AND GAS-TIGHT.

UNDERGROUND VALVE.

The advantages of this Patent Valve over all others yet introduced are, that it is always as tight as the best wedge or spring valve, without the possibility of setting fast or becoming suddenly leaky. The surfaces not being in contact during the operation of opening or closing, leakage through wear and tear is avoided.

The Gas Engineer will not fail to see the importance of such a valve in connexion with his purifying apparatus, particularly in the case of large sizes.

The slide being operated either by a screw and nut, or by a pinion and rack, a cam bearing upon a plane, cast on the back of the Valve, forces it against the face, and renders the escape of gas an impossibility. By a slight turn of the pinion or screw, the slide is released, and brought away from the face, by which means friction is avoided, and the only force required to open the Valve is that due to its own weight.

SOLE MANUFACTURERS:

S. OWENS AND CO.,

HYDRAULIC AND GENERAL ENGINEERS,

WHITEFRIARS STREET, LONDON, E.C.

PRICES, SIZES, AND FULL PARTICULARS ON APPLICATION.

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AND

WENLOCK IRON WHARF, 21 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,

Keep in London and at their works large stocks of PIPES and CONNEXIONS (1½ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

CHARLES HORSLEY, Agent.

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Manufacturers of THE ORIGINAL SILICA OR DINAS FIRE-BRICKS. Specially adapted for Gas-Retort Furnaces, and for Siemens's Gas-Furnaces. Shipments promptly executed to London, Liverpool, Hull, Grimsby, &c.

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BEST GLASS-HOUSE POT and CRUCIBLE CLAYS.

Successors to

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Of all Dimensions for Gas-Works,

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Of every kind.

The Highest Award was obtained by H. & M., at the Philadelphia Exhibition, 1876, for Superior Quality of Manufacture.

GAS AND WATER PIPES.

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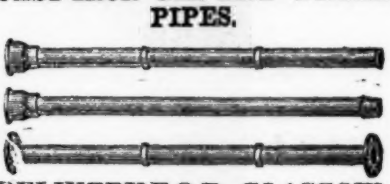

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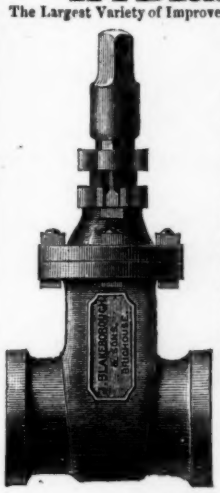
Prices on application.

SLUICE VALVES.

The STRONGEST, CHEAPEST, & BEST in the TRADE.

HYDRANTS.

The Largest Variety of Improved Designs in the Market.



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SLUICE VALVES for Water.
DO. for Gas and Sewage, 1½ to 48 in.
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REFLUX VALVES.
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Compound HYDRANTS.
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Tested with 600 to 900 feet head of pressure.

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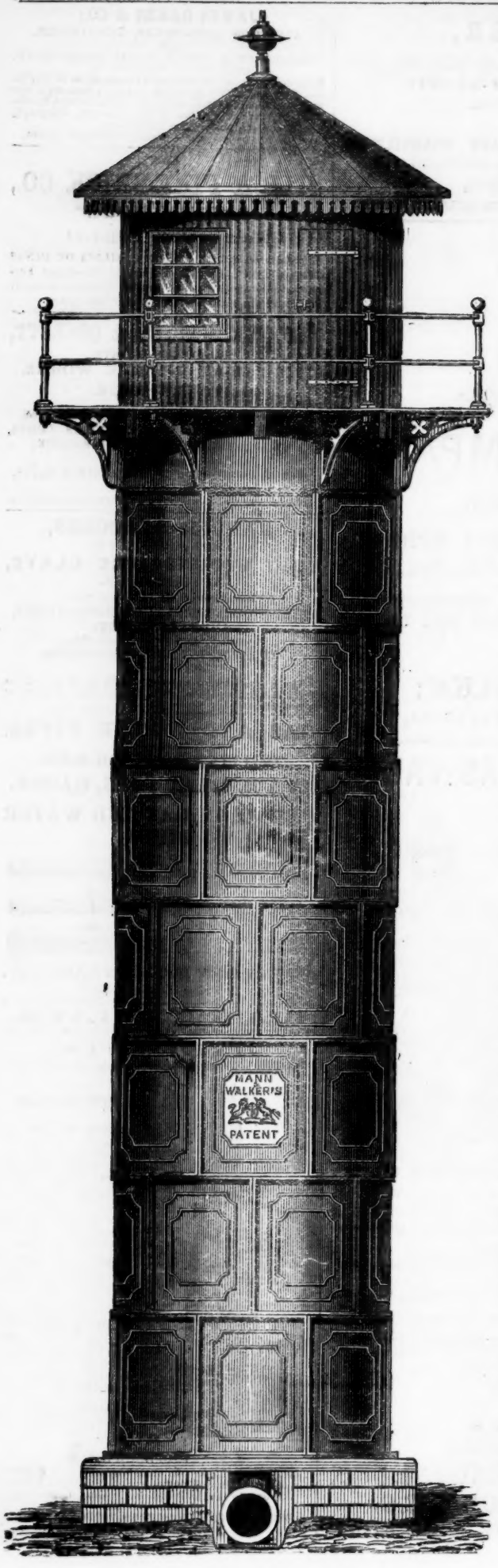
Where Samples may be seen.



C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im- portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

Fifty million cubic feet of gas per 24 hours are purified from ammonia by these Patent Scrubbers in a winter's day in the gas-works of London, where the purity of gas supply is the highest in the world, under the chemical restrictions of the Board of Trade.

Generally, wherever a high standard of purification is maintained in the chief cities and towns of the British Provinces and of Europe, these Scrubbers have become established.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, re- quiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

SAMUEL CUTLER & SONS,

CONTRACTORS FOR GAS AND WATER WORKS, GENERAL ENGINEERS,

IRONFOUNDERS, AND MANUFACTURERS

OF

GASHOLDERS, TANKS, PURIFIERS,

SCRUBBERS, VALVES, EXHAUSTERS, IRON ROOFS, BRIDGES, BOILERS,

AND

GENERAL CAST AND WROUGHT IRON WORKS.

S. C. & Sons undertake the entire Erection of New, or Remodelling of existing Gas-Works in any part of the World, including small Works for MANSIONS, FACTORIES, &c., or Works of the largest extent (are now constructing the largest Gasholder yet erected); also the Supplying and Laying of MAINS.

They make a speciality of supplying every requisite whatever for a Gas-Work, keeping in Stock what are most in request. WOOD SIEVES for Purifiers and Scrubbers, of a superior make.

SPECIAL CASTINGS to Drawing or Pattern at Shortest Notice.

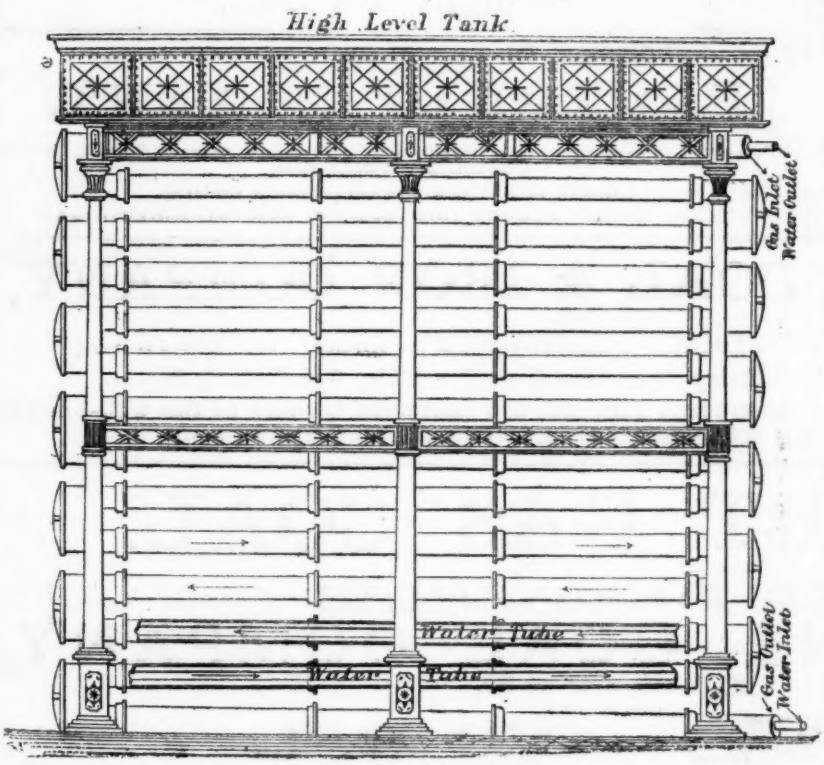
MANUFACTURERS OF

MORRIS & CUTLER'S PATENT CONDENSER

AND

CUTLER'S PATENT GAS-WASHER.

(For Illustration and Description, see "Journal" for June 25, page 997.)



Description of Morris & Cutler's Patent Condenser.

The Condenser may consist of pipes arranged in tiers as shown, or in any other form most convenient to the site available, each tier being connected with special connexions, and containing within same either one or more coils of smaller pipe through which water is passed, being supplied from any convenient source of supply, the water passing in an opposite direction to the gas, so that the coldest water is at the gas outlet. The power of the Condenser can be regulated precisely in proportion to the quantity of water allowed to pass through, which is not in any way contaminated, but simply heated by the hot gas, and advantage can be taken of its being at a high level to carry it to a high-level cistern, from whence it can be used for supply to boiler or any other purpose. (The Condenser itself may form the support for a high-level cistern as illustrated.) By an arrangement of valves the water may be shut off, and an air orifice opened, when air will pass through instead of water, or both air and water can be shut off. The power of the Condenser is, therefore, entirely under control.

The Condenser may be seen in operation at the Brentford Gas-Works.

For further Particulars, apply to

Mr. F. MORRIS, GAS-WORKS, BRENTFORD,

OR TO

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PROVIDENCE WORKS, MILLWALL (Near the Steamboat Pier), LONDON, E.

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CANNEL COAL MERCHANT,

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SHOTT'S BOGHEAD.

LOTHIAN'S CANNEL

Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

OLD WEMYSS CANNEL

Yields 13,320 cubic feet of 32·5-candle gas per ton.

Prices and full Analyses on application.

GAS COAL.

POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, NEAR LEEDS.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES M'KELVIE,

CANNEL COAL MERCHANT,

HAYMARKET, EDINBURGH.

Established 1840.

HEBBURN MAIN GAS COALS.

T. Stone, Esq., of Weymouth, writes on Nov. 17, 1876: "I have used about 12,000 tons of this Coal, with, I think, the best possible results, although not always under the most favourable circumstances. My Coal account made up to Midsummer last showed a makeage of 10,524 cubic feet per ton of 14½-candle gas, and not a hundredweight of Cannel used. This statement would, I know, be incredible to many men, and may provoke the remark, 'How much of it is paid for?' For the gratification of such, I have to say that, of the above quantity, 9866 cubic feet per ton of Coal carbonized were brought to charge and duly paid for, with the exception of about 6s. per cent. for bad debts. The coke is of excellent quality. The above facts I hold to be a greater recommendation to your Coal than any words of mine could be."

PRICES ON APPLICATION, EITHER F.O.B. OR BY RAIL IN TRUCK LOADS.

THE TYNE COAL COMPANY, LIMITED, OWNERS.
W. RICHARDSON, Fitter,
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FERRAND DAVIES,

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AGENT FOR

THOMAS BARR'S LESMAHAGOW MAIN CANNEL,

AND

NEWTON, CHAMBERS, & CO.'S SILKSTONE GAS COALS.

Analyses and Quotations on application.

WILSON CARTER AND PEARSON,

GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station or for Export all kinds of Fuel for Gas purposes.

Address—CHIEF OFFICES:

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CANNEL COAL.

ELLIS LEVER & CO., Central Coal Offices, 46, Cannon Street, London, E.C., and 6, Piccadilly, Manchester, are prepared to contract for the supply of THE BEST CLASSES of CANNEL and GAS COAL, for long or short periods. Analysis and prices on application.

ELLIS LEVER & CO.,

CANNEL AND GAS COAL CONTRACTORS,

Shippers of Steam and House Coal

AT ALL

ENGLISH, SCOTCH, AND WELSH PORTS.

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AND

6, PICCADILLY, MANCHESTER.

ECONOMY IN THE PRODUCTION OF GAS.

PLUTONIC CEMENT,

For Jointing and Repairing Retorts and Ovens *in* action and *out* of action.

A Pamphlet on the advantages of the above, with modes of Application, References, Prices, &c., free by post, from the Sole Manufacturer,

WILLIAM RICHARDSON, GAS AND HYDRAULIC ENGINEER,

CHARLES HENRY STREET AND BISSELL STREET, BIRMINGHAM.

THE WIGAN COAL & IRON COMPANY,

LIMITED.

DISTRICT OFFICE: 97, NEW STREET, BIRMINGHAM; AGENT: W. M'GOWAN;

Supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, &c.

N.B.—The Wigan Coal and Iron Company, Limited, are exclusive owners of the well-known HAIGH HALL AND KIRKLESS HALL GAS COAL COLLIERIES.

ALBERT GAS COAL.

THE DERBYSHIRE

SILKSTONE COAL COMPANY,

LIMITED,

CAN OFFER A

GAS COAL

Of superior quality, delivered in trucks at any Railway Station in England, or shipped on board at Hull, Grimsby Docks, or Barrow-in-Furness.

Purified gas per ton of coal in cubic feet (average)	10,775
Illuminating power in candles	14·71
Weight of coke in lbs. per ton of coal	1,502

ANALYSIS AND PRICES ON APPLICATION TO

Mr. EDMUND TAYLOR, Secretary,

ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

DODWORTH, BARNSLEY.

BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
Mr. RICHARD HARTLEY . . . . . Managing Director.

REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

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HYDRATED PURIFYING MATERIAL.

Samples on application.

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PRICES ON APPLICATION.

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A recent extensive development of the Collieries enables us to offer increased supplies.

JAS. PATERSON, Esq., of Warrington, after testing various qualities of our Coal, has sent the following testimony of their merits:—

"Warrington Gaslight and Coke Company,
Offices, Mersey Street, Warrington, April 23, 1877.

"MESSRS. NEWTON, CHAMBERS, AND CO.,

"GENTLEMEN,—After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

"The average of Nine samples gives a yield of **12,500** cubic feet of **15½**-Candle Gas, being equivalent to **664** lbs. of sperm per ton, and **1420** lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

"Yours truly, "JAMES PATERSON."

Full particulars will be sent on application to us—address as above.

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